Hazardous Air Pollutant Emissions for Miscellaneous Coating Manufacturing

Supplementary Information Document for Proposed Standards

Emission Standards Division

U. S. Environmental Protection Agency
Office of Air and Radiation
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

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ALPHA-GAMMA
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MEMORANDUM

DATE: June 7, 1999

SUBJECT: New Source MACT Floors for Surface Coating Manufacturing Processes

FROM: Chuck Zukor and Reese Howle
Alpha-Gamma Technologies, Inc.

To: Miscellaneous Organic NESHAP Project File

The purpose of this memorandum is to summarize the maximum achievable control technology (MACT) floor determinations for surface coating manufacturing processes at new sources which are covered by the Miscellaneous Organic NESHAP (MON). Material discussed in this memorandum includes:

1) Background information and the new source MACT definition;
2) Determination of the new source MACT floor for process vents;
3) Determination of the new source MACT floor for storage tanks;
4) Determination of the new source MACT floor for wastewater; and
5) Determination of the new source MACT floor for equipment components.

1.0 BACKGROUND

This section presents background information on development of new source MACT floors for MON surface coating manufacturing processes. Section 1.1 describes the available information used in the new source MACT floor determinations. While, Section 1.2 discusses the required guidelines for determining new source MACT floors and provides a summary of the resulting new source MACT floor determinations for MON surface coating manufacturing processes.

1.1 Available Information

The MACT floor determinations for new sources are based on the same information used for the MACT floor determinations for existing sources. In general, information on surface coating manufacturing processes was obtained from responses to Section 114 surveys. The MON surface coatings database contains information from 127 facilities which represents extensive coverage of the affected source categories.

1.2 New Source MACT Floor Determinations

The Clean Air Act as amended in 1990 requires EPA to promulgate emission standards to reflect the maximum degree of reduction in HAP emissions that EPA determines is achievable for new or existing sources. This control level is referred to as MACT. The Act also prescribes a method for determining the least stringent level allowed for a MACT standard, which is known as the "MACT floor."

For new sources, the standards for a source category or subcategory "shall not be less stringent than the emission control that is achieved in practice by the best controlled similar source, as determined by the Administrator" [section 112(d)(3)]. New source MACT floors for MON surface coating manufacturing processes are based on the best controlled similar source for each emission type, using the available data. Table 1 provides a summary of the new source MACT floor determinations for surface coating manufacturing processes. The new source MACT floors and the methodology used to determine these floors are described in the following sections.

Table 1. New Source MACT Floor Determinations for Chemical Processes

Source Type	Required Control	Performance Level	
Process Tanks/ Vessels	Fixed or removable cover venting to a control device capable of a 95 percent reduction	All portable process tanks $\geq$ 250 gal	All stationary process tanks $\geq$ 250 gal
Storage Tanks	80 percent reduction	Tank with capacity $\geq$ 10,000 gal and HAP partial pressure $\geq$ 0.2 psia	
Wastewater	Equivalent to the HON	Wastewater streams with total VOHAP[a] concentration $\geq$ 1,600 ppmw and a flow rate $\geq$ 880 gal/yr	
Equipment Components	Equivalent to the bulk gasoline terminal “sensory” LDAR program	All affected processes.	

[a] VOHAP is described in Table 9 of the HON rule (40 CFR 63, Appendix to Subpart G). Table 9 lists the volatile organic HAP (VOHAP) which volatilize readily from wastewater and are characterized by Henry’s Law constants greater than or equal to 1.51×10^{-6} atm-m^3/mol.

2.0 PROCESS TANKS/VESSELS NEW SOURCE MACT FLOOR DETERMINATION

As with existing process tanks/vessels, a class distinction was established between portable and stationary new source process tanks. Therefore, separate new source MACT floors were determined for portable and stationary process tanks:

- The new source MACT floor for portable process tanks with a capacity of 250 gallons or more is a fixed or removable cover which vents to a control device with an overall HAP reduction efficiency of 95 percent or greater.

- The new source MACT floor for stationary process tanks with a capacity of 250 gallons or more is a fixed or removable cover which vents to a control device with an overall HAP reduction efficiency of 95 percent or greater.

The class distinction between portable and stationary process tanks is discussed in Section 2.1. In Section 2.2, the MACT floor level of performance is discussed. Section 2.3 describes the top performing process tanks used in the new source MACT floor determination.

2.1 Class Distinctions

As with the MACT floor for existing sources, a class distinction was established between portable and stationary process tanks due to differences in applying technologies to reduce emissions from portable and stationary process tanks. The mobile nature of portable process tanks requires different technical considerations for controlling emissions with an add-on control device than do stationary process tanks.

2.2 New Source MACT Floor Level of Performance

For both portable and stationary process tanks, the level of performance determined for the new source MACT floors is a fixed or removable cover which vents to a control device achieving a HAP emission reduction efficiency of 95 percent or more. Coincidentally, the 95 percent performance level is the best demonstrated performance level for both portable and stationary process tanks as demonstrated below:

- 72 portable process tanks located at BASF in Belvidere, NJ are reportedly controlled by a thermal oxidizer achieving a 95 percent control efficiency; and

- 3 stationary process tanks located at BASF in Detroit, MI are reportedly controlled by a carbon absorber achieving a 95 percent control efficiency.

Portable and stationary process tanks at PPG Industries in Springdale, PA are reportedly achieving HAP emission reductions greater than 95 percent. This higher

HAP emission reduction was obtained through the use of fixed covers which vent to a thermal oxidizer. However, source test data necessary to support and validate the reported HAP emission reductions of 99 percent were not available. In addition, diverse process tank characteristics such as fixed and removable covers, varying flow rates, types of pollutants, and pollutant concentrations make it difficult to conclude an efficiency of 99 percent or more can be achieved for all covered process tanks. Therefore, the control achieved by the PPG process tanks are not considered the best demonstrated performance level for a similar source.

Two stationary process tanks located at Dexter Aerospace Materials in Pittsburg, CA were reported as also achieving HAP emission reductions greater than 95 percent. The two process tanks were reported as achieving a 98.5 percent reduction in HAP emissions through the use of a thermal oxidizer. These process tanks are used as mixing tanks to support the application of adhesives in the manufacture of fiber composites. As an aerospace fiber composite manufacturer, Dexter Aerospace Materials is a major source of HAP and a thermal oxidizer was installed to comply with the requirements of the aerospace MACT standard. Emissions from the two adhesive mix tanks were manifolded to the thermal oxidizer for control. The two process tanks located at Dexter Aerospace Materials are not considered a similar source because the source is primarily a manufacturer of aerospace fiber composites covered by the aerospace MACT standard. Not all MON sources have a common control device with available capacity to add vent streams from process tanks.

2.3 Top Performing Process Tanks

The new source MACT floors for both portable and stationary process tanks are established with the same performance criteria used for determining the existing source MACT floors. Criteria used for both portable and stationary process tanks was the reported HAP reduction efficiency (percent by weight) of the combined cover and control device.

2.3.1 Portable Process Tanks

The new source MACT floor for portable process tanks was established by considering all portable process tanks located within each facility. The overall HAP reduction efficiency for controlled portable process tanks was selected as the measure of performance to rank order and determine the best performing facility. The performance criteria corresponding to the best facility was an overall HAP reduction efficiency value of 95 percent. The BASF facility in Belvidere, NJ is currently controlling 72 of 82 portable process tanks at a level of 95 percent through the use of fixed covers and a thermal oxidizer. The remaining portable tanks are equipped with conservation vents (CV) and flame arrestors (FA) which were reported as having no affect on HAP emission reductions. All portable tanks reported by BASF in Belvidere, NJ are characterized by the smallest reportable capacity range of “A,” or 250 gal to 500 gal. Attachment A provides the top MACT floor rankings for portable process tanks with the corresponding number of tanks controlled, type of control device, and overall HAP reduction efficiency.

2.3.2 Stationary Process Tanks

As with the portable process tanks, the new source MACT floor for stationary process tanks was established by considering all stationary process tanks located within each facility. The overall HAP reduction efficiency for controlled stationary process tanks was selected as the measure of performance to rank order and determine the best performing facility. The performance criteria corresponding to the best facility was also an overall HAP reduction efficiency value of 95 percent. Three out of 113 stationary process tanks are currently controlled at a level of 95 percent at BASF in Detroit, MI through the use of removable covers and a carbon absorber. The remaining stationary tanks are not equipped with HAP emission reduction devices. The controlled stationary tanks are characterized by the smallest reportable capacity range of “A,” or 250 gal to 500 gal. While, the capacity of the uncontrolled stationary tanks span reportable capacity ranges of “A” (250 to 500 gal) to “F” (5,001 to 10,000 gal).

In addition, 5 other facilities (e.g., BASF/Belvidere, NJ; CYTEC Engineered Materials/ Havre de Grace, MD; DuPont/Mt. Clemens, MI; Morton International/West Alexandria, OH; and Sherwin-Williams/Columbus, OH) reported HAP emission reductions of 95 percent for an additional 152 stationary process tanks using a variety of control techniques. Attachment B provides the top MACT floor rankings for stationary process tanks with the corresponding number of tanks controlled, type of control device, and overall HAP reduction efficiency.

3.0 STORAGE TANK NEW SOURCE MACT FLOOR DETERMINATION

The new source MACT floor for storage tanks was determined to be an internal or external floating roof (IFR or EFR), or a control device with a HAP reduction efficiency of 80 percent or greater for all tanks with a capacity of 10,000 gallons or greater and storing a material with a HAP partial pressure of 0.2 psia or greater.

The attempt to establish a class distinction between storage tanks is discussed in Section 3.1. In Section 3.2, the MACT floor level of performance is discussed. Section 3.3 describes the top performing storage tanks population used in the new source MACT floor determination.

3.1 Class Distinctions

A class distinction between capacity ranges of new source storage tanks was evaluated but the results did not support any class distinction. As with other MACT standards, such as the HON, class distinctions have been established for three classes of tanks based on the following storage capacity ranges:

- 10,000 to less than 20,000 gal,
- 20,000 to less than 40,000 gal, and
- 40,000 gal or greater.

To support this type of class distinction among storage tanks, the application of HAP controls tend to be more stringent for larger tanks and less stringent for smaller tanks. However, for the small number (20 out of 522) of tanks reporting HAP reduction devices, only the opposite of the anticipated trend was observed. More than half of the controlled tanks were characterized in the smallest storage capacity range of 10,000 gal to less than 20,000 gal. The remaining controlled tanks were characterized in the median capacity range of 20,000 gal to less than 40,000 gal. While, no controls were reported for tanks with a storage capacity of 40,000 gal or greater. Therefore, tank storage capacity is not a technical criteria distinguishing the type and stringency of controls applied to the best performing storage tanks. Therefore, all tanks with storage capacities of 10,000 gal or greater were considered for determining the new source MACT floor.

3.2 New Source Performance Level

The level of performance determined for the new source MACT floor is a tank equipped with an internal or external floating roof (IFR or EFR), or another control device with a HAP emission reduction efficiency of 80 percent or more, excluding scrubbers. By considering a combination of the control efficiency, tank storage capacity, and HAP partial pressure of stored material, the best demonstrated overall performance level is a HAP emission reduction of 80 percent for all tanks with a capacity of 10,000 gal or greater.

The best overall performance level was reported by PPG Industries in Cleveland, OH. This facility reported a HAP emission reduction of 80 percent for multiple 10,000 gal tanks venting to a thermal incinerator. The PPG facility demonstrates the highest degree of HAP reductions achieved from tanks, including those with the lowest reported storage capacity of 10,000 gal. Therefore, the reported performance level of 80 percent is the best achievable performance level for all similar storage tanks.

Although Torrence Coatings and Resins in Torrence, CA reported a higher absolute performance level for storage tanks, the reported performance level was not considered representative of all similar sources. The smallest controlled tank at Torrence Coatings and Resins is a 15,000 gal storage tank equipped with a carbon absorber. The HAP reduction efficiency of the carbon absorber was reported as 90 percent. The Torrence Coatings and Resins facility reported a tank performance level for only a portion of the storage capacity range, 15,000 gal or greater. Thus, the reported performance level is not representative of all storage tanks within the full capacity range of 10,000 gal or more. Therefore, the performance level characterized by the PPG facility is considered better than the Torrence Coatings and Resins facility. Additional HAP emission reductions can be achieved with 80 percent reductions from all tanks with capacities of 10,000 gal or more compared to 90 percent reductions from all tanks with capacities of 15,000 gal or more.

3.3 Top Performing Storage Tanks

The new source MACT floor for storage tanks was established by considering all tanks located in each facility operating surfacing coating manufacturing processes as the affected source. The measure of performance to rank order and determine the best performing source was the HAP partial pressure of the stored material in each tank. As discussed previously, the facility with the best overall performance level was PPG Industries in Cleveland, OH. This facility reported five identical tanks each storing a glycol ether and methyl isobutyl ketone mixture with a total HAP partial pressure of 0.2 psia. Thus, the performance criteria corresponding to the best performing source is a HAP partial pressure of 0.2 psia. Attachment C provides the top MACT floor rankings for storage tanks with corresponding HAP partial pressure values.

4.0 WASTEWATER NEW SOURCE MACT FLOOR DETERMINATION

The new source MACT floor for wastewater streams generated by MON surface coating manufacturing processes was determined to be the same as the HON new source MACT floor for wastewater. Control requirements to meet the HON new source floor includes several options. Floor control requirements can be met using a steam stripper meeting a minimum set of design specifications. Another option is to use a control device capable of meeting HAP-specific mass fraction removal (Fr) efficiency as specified in Table 9 of the HON rule (40 CFR 63, Subpart G). Therefore, HON control requirements apply to each individual wastewater stream with a total VOHAP concentration of 1,600 ppmw or more and a flow rate of 880 gal/yr or more.

The performance level for the new source MACT floor is discussed in Section 4.1. While, Section 4.2 describes the top performing wastewater streams used in the new source MACT floor determination.

4.1 New Source MACT Floor Level of Performance

Combustion at off-site locations is the control reported at the top performing facility for wastewater streams. The EPA did not request data on the efficiency of wastewater control devices. However, general engineering design knowledge of combustion devices supports VOHAP emissions reduction equivalent to the HON requirements. Thus, the MACT floor performance level for new wastewater sources has been demonstrated as achievable at the top performing facility. This level of performance is no less stringent than the performance level determined for MON existing sources.

4.2 Top Performing Wastewater Streams

The new source MACT floor for wastewater streams was established by considering each wastewater stream located in each facility operating surfacing coating manufacturing processes as the affected source. The measure of performance to rank order and determine the best performing source was the HAP concentration and annual flow rate of the wastewater. The facility with the best overall performance level was Lilly Industries in Montebello, CA. This facility reported a wastewater stream with a total HAP concentration of 1,600 ppmw and wastewater flow rate of 880 gal/yr which is treated in a combustion device (i.e., fuel blending - energy recovery) at an off-site location. Thus, the performance criteria corresponding to the best performing source is a HAP concentration of 1,600 ppmw or more and wastewater flow rate of 880 gal/yr or more. Attachment D provides the top MACT floor rankings for wastewater streams with corresponding HAP concentrations values and treatment codes.

5.0 EQUIPMENT COMPONENT NEW SOURCE FLOOR DETERMINATION

The new source MACT floor for equipment components was determined to be a monthly sensory leak detection and repair (LDAR) program equivalent to the bulk gasoline terminal NESHAP. The new source MACT floor for equipment components was established by considering LDAR programs implemented at each facility operating surface coating manufacturing processes. Several LDAR program characteristics such as leak detection method, leak definition, and inspection frequency were used as the measure of performance to rank order and determine the best performing facility. This same approach was used for determining the existing source MACT floor for equipment components. The performance criteria corresponding to the best similar source was a monthly sensory LDAR program equivalent to the bulk gasoline terminal NESHAP. Approximately 38 of 49 facilities with surface coating manufacturing processes have implemented a monthly sensory LDAR program similar to the bulk gasoline terminal NESHAP.

One facility, PPG Industries in Oak Creek, WI, reported a LDAR program based on detecting equipment leaks using a portable organic vapor analyzer (OVA) as described by EPA Method 21. A leak definition of 10,000 ppmv and multiple inspection frequencies (monthly, quarterly, and annually) were also reported. The LDAR program was implemented to comply with State of Wisconsin VOC RACT requirements for paint manufacturers (Wisconsin Statute 421.06). However, this LDAR program is not considered significantly more stringent than the monthly sensory LDAR program already implemented by most surface coating manufacturers based on conclusions reached under the bulk gasoline NESHAP.

During the development of the bulk gasoline terminal NESHAP, the EPA agreed with an assessment performed by the American Petroleum Institute (API) that the difference between emission factors for terminals performing periodic LDAR with an OVA and those performing a sensory LDAR was statistically insignificant. Equipment associated with bulk gasoline terminals appear similar to equipment associated with surface coating manufacturing processes for the following reasons:

- Equipment components primarily support the transfer of various liquid raw materials and products,

- Equipment components are generally operated only under a slight pressure head developed from transfer pumps, and

- Equipment components developing a leak in liquid-service and under little to no pressure can be detected effectively through sensory observations for drips, odors, and/or hissing sounds.

From drawing upon these similarities, it is considered reasonable that surface coating manufacturing processes performing a LDAR with an OVA and those performing a sensory LDAR will also be statistically insignificant. Thus, the best performing source is one implementing a monthly sensory LDAR program equivalent to the bulk gasoline terminal NESHAP.

ATTACHMENT A

MACT FLOOR RANKING FOR
PORTABLE PROCESS TANKS/VESSELS

TABLE A: FLOOR FOR SURFACE COATING MANUFACTURING "PORTABLE" PROCESS TANKS/VESSELS

	Plant Name	Number of Tanks	Type of Cover	Control Device	Control Efficiency (Percent)
1	PPG Industries, Inc. - Springdale Paint Plant	15	Yes-Removable	Baghouse/thermal oxidizer unit	99
2	BASF Corporation - Belvidere	72	Yes-Fixed	T.O.	95
3	Daniel Products Company, Inc.	21	Yes-Removable	Carbon adsorber	85
4	Aexcel Corporation	15	YES-Removable	None	0
5	Akzo Nobel Coatings	25	NO	None	0
6	AKZO NOBEL COATINGS INC.	11	Yes-Removable	None	0
7	Akzo Nobel Coatings Inc.	69	Yes-Removable	None	0
8	AKZO NOBEL COATINGS INC.	33	No	None	0
9	AKZO NOBEL COATINGS INC.	24	Yes-Removable	None	0
10	Akzo Nobel Coatings Inc.	46	YES-REM	NA	0
11	AKZO NOBEL COATINGS INC.	7	Yes-Removable	None	0
12	Akzo Nobel Coatings Inc.	87	Yes-Removable	None	0
13	Akzo Nobel Coatings Inc.	70	Yes-Removable	None	0

ATTACHMENT B

MACT FLOOR RANKING FOR STATIONARY PROCESS TANKS/VESSELS

TABLE B: FLOOR FOR SURFACE COATING MANUFACTURING "STATIONARY" PROCESS TANKS/VESSELS

	Plant Name	Number of Tanks	Type of Cover	Control Device	Control Efficiency (Percent)
1	PPG Industries, Inc. - Springdale Paint Plant	16	Yes-Fixed	Baghouse/thermal oxidizer unit	99
2	Dexter Aerospace Materials	2	Yes-Fixed	Oxidizer	98.5
3	BASF Corporation	3	Yes-Removable	CA	95
4	BASF Corporation - Belvidere	84	Yes-Fixed	T.O.	95
5	CYTEC ENGINEERED MATERIALS INC.	3	Yes-Fixed	CONDENSER	95
6	CYTEC ENGINEERED MATERIALS INC.	1	Yes-Removable	CONDENSER	95
7	DuPont Mt. Clemens Plant	29	Yes-Fixed	AB	95
8	Morton-West Alexandria, OH	5	Yes-Fixed	Regenerative thermal oxidizer	95
9	Sherwin-Williams Columbus	30	Yes-Fixed	Zeolite canister	95
10	Morton-West Alexandria, OH	2	Yes-Fixed	Dry ice chilled condenser	90
11	RBH Dispersions	1	Yes-Removable	VACUUM CONDENSER	90
12	CYTEC ENGINEERED MATERIALS INC.	2	Yes-Fixed	CONDENSER	85
13	Daniel Products Company, Inc.	14	Yes-Removable	Carbon adsorber	85

ATTACHMENT C

MACT FLOOR RANKING FOR STORAGE TANKS

TABLE C: FLOOR FOR SURFACE COATING MANUFACTURING STORAGE TANKS

	Plant Name	Tank ID	Tank Description	Control Device	Control Efficiency (percent)	Tank Capacity (gallons)
1	Torrance Coatings and Resins Plant, Torrance, CA	TK117	A,D	Carbon Absorption	90	15,000
2	Torrance Coatings and Resins Plant, Torrance, CA	TK16	A,D	Carbon Absorption	90	20,000
3	Torrance Coatings and Resins Plant, Torrance, CA	TK17	A,D	Carbon Absorption	90	20,000
4	Torrance Coatings and Resins Plant, Torrance, CA	TK60	A,D	Carbon Absorption	90	20,000
5	Torrance Coatings and Resins Plant, Torrance, CA	TK15	A,D	Carbon Absorption	90	25,000
6	Torrance Coatings and Resins Plant, Torrance, CA	TK1	A,D	Carbon Absorption	90	25,000
7	PPG Industries, Inc. - Cleveland, OH, Cleveland, OH	32-T-104	A, D, T	Thermal incinerator	80	10,000
8	PPG Industries, Inc. - Cleveland, OH, Cleveland, OH	32-T-105	A, D, T	Thermal incinerator	80	10,000
9	PPG Industries, Inc. - Cleveland, OH, Cleveland, OH	32-T-110	A, D, T	Thermal incinerator	80	10,000
10	PPG Industries, Inc. - Cleveland, OH, Cleveland, OH	32-T-112	A, D, T	Thermal incinerator	80	10,000
11	PPG Industries, Inc. - Cleveland, OH, Cleveland, OH	32-T-111	A, D, T	Thermal incinerator	80	10,000
12	Dexter Packaging Products, Birmingham, Birmingham, AL	13	A, D	Carbon tray	30	12,000

Tank Description Codes:

A=Closed tank vented to a control device
V=Closed tank with vapor balancing
H=Horizontal tank
D=Vertical tank
C=Closed tank with conservation vents
U=Underground tank
T=Constant temperature
O=Other

ATTACHMENT D

MACT FLOOR RANKING FOR WASTEWATER STREAMS

TABLE D: FLOOR FOR SURFACE COATING MANUFACTURING WASTEWATER STREAMS

	Plant Name	Wastewater ID	Flow Rate (gal/yr)	HAP Concentration (ppmw)	Treatment Code
1	Lilly Industries (USA), Inc., Montebello, CA	WW02	880	1,600	*OF-Combustion, RCRA waste
2	Akzo Nobel Coatings Inc., Pontiac, MI	WBP	18,971	2,000	*OF-Combustion, RCRA waste
3	Sherwin-Williams Greensboro, Greensboro, NC	WW1	22,000	4,000	*OF-Combustion, RCRA waste
4	Lilly Industries (USA), Inc., Montebello, CA	WW01	7,000	40,000	*OF-Combustion, RCRA waste
5	Morton-West Alexandria, OH, West Alexandria, O	LF	4,300	100,000	*OF-Combustion, RCRA waste
6	The Glidden Company Reading Plant, Reading, PA	CWW	11,000	1,200	HT, TT, DP
7	Sherwin-Williams Garland, Garland, TX	WW1	500,000	10,000	OF-Landfill solidification
8	PPG Industries, Inc. - East Point, GA, East Point, G	EPXCWLL201	13,500	210,000	TT
9	PPG Industries, Inc. - Oak Creek, WI, Oak Creek,	Tank 1909	357,000	3,000	TT, DP
10	Valspar Coatings - Garland, Garland, TX	Latex	500,000	10,000	TT/DP

Wastewater Treatment Codes:

HT=Holding tank
BI=Biological treatment
CL=Clarifier
SS=Steam stripper

OP=Open pond
EQ=Equalization pond
TT=Treatment tank
OF=Offsite destruction

AS=Air stripper
DP=Discharge to a POTW
O=Other

MEMORANDUM

DATE: June 22, 1999

SUBJECT: Existing Source MACT Floors for Surface Coating Manufacturing Processes

FROM: Chuck Zukor and Reese Howle
Alpha-Gamma Technologies, Inc.

To: Miscellaneous Organic NESHAP Project File

The purpose of this memorandum is to summarize the maximum achievable control technology (MACT) floor determinations for surface coating manufacturing processes at existing sources which are covered by the Miscellaneous Organic NESHAP (MON). Material discussed in this memorandum includes:

1) Regulatory background including standard applicability, available information for MACT analyses, and MACT definitions;

2) Determination of the existing source MACT floor for process tanks/vessels;

3) Determination of the existing source MACT floor for storage tanks;

4) Determination of the existing source MACT floor for wastewater; and

5) Determination of the existing source MACT floor for equipment components.

1.0 BACKGROUND

This section presents some background on the development of MACT floors for MON surface coating manufacturing processes. Section 1.1 summarizes the facility applicability criteria for MON surface coating manufacturing processes. Section 1.2 describes the available information used in the MACT floor determinations. Section 1.3 summarizes the required guidelines for determining MACT floors and a summary of the resulting MACT floor determinations.

1.1 MON Surface Coating Manufacturing Applicability Criteria

The MON will apply to facilities meeting all of the following criteria:

- Manufacture paints, varnishes, lacquers, enamels, and allied products, adhesives and sealants, or printing ink;
- Emit a hazardous air pollutant (HAP) and considered a major source;
- Are covered by one of the following Standard Industrial Classification (SIC) codes: 2851, 2891, or 2893; and
- Are not covered by any other MACT standard.

Additional details regarding applicability of the MON were published in the Federal Register on November 7, 1996 (61 FR 57602).

1.2 Available Information

The Environmental Protection Agency (EPA), under the authority of Section 114 of the 1990 Clean Air Act Amendment, requested information from facilities which are subject to the MON and which manufacture surface coatings such as paints and adhesives. The Section 114 requests were sent to a total of 194 facilities in a letter from the EPA on January 28, 1997 with a clarification letter sent on March 10, 1997. The facilities which received the Section 114 questionnaires were identified from EPA's 1993 Toxic Release Inventory (TRI) database. First, facilities which had a SIC code of 2851, 2891, or 2893 were identified. Then, facilities which had total actual HAP emissions greater than 12.5 tons/yr or actual emissions of one HAP greater than 5 tons/yr were identified.

Section 114 requests were sent to an additional 24 surface coating manufacturing facilities in a letter from the EPA on May 18, 1998. Facilities receiving the second set of Section 114 questionnaires were identified from a May 12, 1998 letter from the National Paint & Coatings Association (NCPA). The additional Section 114 requests were sent to facilities that were either not surveyed or did not respond to the original Section 114 request.

Facilities were requested to provide process and emissions data for the 1995 calendar year on a computer disk or hard-copy, paper response. Alpha-Gamma entered the data received from the facilities into a MS Access database. The MON surface coating database contains data from 127 facilities. Some of the data provided were not in the format requested in the Section 114 questionnaire. Alpha-Gamma made the necessary conversions before the MACT floor analyses were performed.

1.3 MACT Floor Determinations

According to the Clean Air Act, the MACT floor for existing sources is defined as "the average emission limitation achieved by the best performing 12 percent of sources (for which the Administrator has emissions information)." In cases where 30 or fewer sources exist in a source category, the MACT floor is defined as the average emission limitation achieved by the best performing 5 sources. The EPA has interpreted the word "average" in 59 FR 29196 as a measure of the "central tendency of a data set." The central tendency may be represented by the arithmetic mean, median, or some other measure that is reasonable. The MACT floors for MON surface coating manufacturing processes are based on the central tendency for each emission type, using the available data. Table 1 provides a summary of the MACT floor determinations for surface coating manufacturing processes at existing sources. The MACT floors and the methodology used to determine these floors are described in the following sections.

Table 1. MACT Floor Determinations for Surface Coating Manufacturing Processes at Existing Sources

Source Type	Required Control	Performance Level
Process Tanks/ Vessels	Fixed or removable cover	All portable process tanks ≥ 250 gal
	Fixed or removable cover venting to a control device capable of a 60 percent reduction	All stationary process tanks ≥ 250 gal
Storage Tanks	None for all tank capacity ranges	Tank with capacity: ≥ 10,000 gal and <20,000 gal ≥ 20,000 gal and <40,000 gal ≥ 40,000 gal
Wastewater	Equivalent to the HON	Wastewater streams with total VOHAP[a] concentration ≥ 4,000 ppmw and a flow rate ≥ 22,000 gal/yr
Equipment Components	Equivalent to the bulk gasoline terminal “sensory” LDAR program	All affected processes.

[a] VOHAP is described in Table 9 of the HON rule (40 CFR 63, Appendix to Subpart G). Table 9 lists the volatile organic HAP (VOHAP) which volatilize readily from wastewater and are characterized by Henry’s Law constants greater than or equal to 1.51×10^{-6} atm-m^3/mol.

2.0 PROCESS TANKS/VESSELS MACT FLOOR DETERMINATION

A class distinction was established between portable and stationary process tanks located at existing sources. Therefore, separate MACT floors were determined for portable and stationary process tanks:

- The existing source MACT floor for portable process tanks with a capacity of 250 gallons or more is a fixed or removable cover.

- The existing source MACT floor for stationary process tanks with a capacity of 250 gallons or more is a fixed or removable cover which vents to a control device with an overall HAP reduction efficiency of 60 percent or greater.

The affected process tank/vessel population used in the MACT floor determination is described in Section 2.1. In Section 2.2, the class distinction between portable and stationary process tanks is discussed. Section 2.3 describes the MACT floor level of performance. Section 2.4 describes the MACT floor determinations.

2.1 Affected Process Tank/Vessel Population

All process tanks/vessels associated with surface coating manufacturing processes were considered. The total source population is 7,639 process tanks/vessel located in 127 facilities. Stationary process tanks/vessels account for approximately 61 percent (4,628) of the process tank population and are located in 122 facilities. While, portable process tanks/vessels account for the remaining 39 percent (3,011) of the process tank population and are located in 88 facilities.

The process tank population has been reduced by 8 stationary tanks since the prior MACT floor determination (September 17, 1998). A memorandum from Mr. Bob Nelson (NCPA) on September 25, 1998 indicated that 8 stationary process tanks were reported incorrectly by Morton International in Lansing, IL. Four of the process tanks were associated with a resin manufacturing operation and were transferred for consideration under the MON chemical manufacturing subcategory. The other four process tanks were actually product storage tanks and were transferred for consideration in the storage tank MACT floor determination.

2.2 Class Distinctions

A class distinction was established between portable and stationary process tanks due to differences in applying technologies to reduce emissions from portable and stationary process tanks. The mobile nature of portable process tanks requires different technical considerations for controlling emissions with an add-on control device.

2.3 MACT Floor Level of Performance

2.3.1 Portable Process Tanks/Vessels

The selected MACT floor level of performance is a fixed or removable cover on a portable process tank. Approximately 92 percent (2,783) of the portable tanks are reportedly equipped with a fixed or removable cover. While, only about 3 percent (108) of the portable tanks are reportedly equipped with a control device (e.g., thermal oxidizer or carbon absorber). Since covers are the most effective emission reduction measure in use by more than 12 percent of MON portable process tanks, a fixed or removable cover corresponds to the MACT floor level of performance.

2.3.2 Stationary Process Tanks/Vessels

The selected MACT floor level of performance is a fixed or removable cover on a stationary process tank which vents to a control device. As with the portable process tanks, approximately 98 percent of the stationary process tanks (4,558) are reportedly equipped with a fixed or removable cover. Approximately 8 percent of the stationary tanks (368 tanks) are also reportedly routing emissions to an add-on control device. Therefore, there is a sufficient number of controlled process vessels to support a MACT floor level of performance for stationary process tanks.

2.4 MACT Floor Determinations

2.4.1 Portable Process Tanks/Vessels

The presence of a cover and the emission reduction efficiency of an add-on control device were selected as the measures of performance to rank order portable process tanks controlled at a MACT floor level. A portable tank equipped with a cover and a control device with a high emission reduction efficiency was considered more stringent than a similar portable tank with just a cover.

All portable process tanks with MACT equivalent controls were first ranked by the corresponding control device efficiency in descending order (high-to-low). Next, portable tanks equipped with covers were ranked in descending order (high-to-low) by the number of tanks located at each facility. The top 12 percent of the 3,011 portable process tanks corresponds to the top 361 tanks. Only 108 of the top 361 portable process tanks are reportedly equipped with a cover and an add-on control device, while the remaining 253 tanks are equipped only with a cover. Since portable process tanks equipped with add-on controls represent less than 6 percent of the affected sources, the “central tendency” of the top performing tanks is a portable process tank equipped only with a fixed or removable cover. At present, a specific HAP emission reduction efficiency corresponding to the sole use of covers to reduce HAP emissions from process tanks has not been determined. Attachment A provides a complete MACT floor ranking with corresponding control device efficiencies for portable process tanks.

2.4.2 Stationary Process Tanks/Vessels

The presence of a cover and the emission reduction efficiency of an add-on control device were selected as the measures of performance to rank order stationary process tanks controlled at a MACT floor level. A stationary tank equipped with a cover and a control device with a high emission reduction efficiency was considered more stringent than a similar stationary tank with a just a cover.

All stationary process tanks with MACT equivalent controls were first ranked by the corresponding control device efficiency in descending order (high-to-low). Next, stationary tanks equipped with covers were ranked in descending order (high-to-low) by the number of tanks located at each facility. The top 12 percent of 4,628 stationary process tanks corresponds to the top 555 tanks. Of the top performing stationary process tanks, 368 tanks are reportedly equipped with a cover and an add-on control device. The remaining 187 tanks are equipped only with a cover. Since stationary process tanks equipped with add-on controls represent approximately 8 percent of the affected sources, a "central tendency" of the top performing tanks can be expressed numerically as a median or mean control efficiency value. The median performance level for the top facilities is an add-on control device with an efficiency of at least 80 percent. While, the average performance level for the top facilities is an add-on control device with an efficiency of at least 60 percent (value rounded up from actual value of 57 percent).[1] It was determined that the average performance level of 60 represented the "central tendency" of the top facilities. Since the control device efficiencies for the top performing facilities represented a fairly even distribution, it was determined that the average control device efficiency best represented the central tendency of the data set. Attachment B provides a complete MACT floor ranking with corresponding control device efficiencies for stationary process tanks.

3.0 STORAGE TANK MACT FLOOR DETERMINATION

The MACT floor for storage tanks located at existing MON surface coating manufacturing facilities was determined to be no control. All storage tanks associated with surface coating manufacturing processes were considered. The total source population is 453 storage tanks located in 82 facilities. A summary of the MON surface coating storage tanks data is provided in Table 2.

Collectively, only about 4 percent (18) of the 453 storage tanks are reportedly equipped with a control device (e.g., thermal oxidizer or carbon absorber). None of the storage tanks are reportedly equipped with an internal or external floating roof. Table 2 also

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[1] The mean control efficiency value was determined as a weighted average. The number of stationary process tanks with add-on controls (368) was multiplied by the running average of control efficiencies corresponding to these controlled tanks (85.7 percent) and then divided by the number of stationary tanks representing the top 12 percent of affected sources (555), 368 * 85.7 / 555 = 57 percent.

groups the storage tank data in three capacity ranges which are consistent with the HON:

- ≥ 10,000 to <20,000 gal,
- ≥ 20,000 to <40,000 gal, and
- ≥ 40,000 gal.

For each storage capacity range, less than 6 percent of the storage tanks are reportedly equipped with a control device. Thus, the MACT floor for MON surface coating storage tanks was determined to be no control. Attachment C provides a MACT floor ranking for tanks reportedly equipped with control devices.

Table 2. Summary of Surface Coating Manufacturing Storage Tank Data

Tank Size (gal)	Total Number of Tanks	Number of Tanks with Add-On Control Devices
≥ 10,000 to <20,000	317	11 (3.5 percent)
≥ 20,000 to <40,000	133	7 (5.3 percent)
≥ 40,000	3	0 (0 percent)
TOTAL	453	18 (4.0 percent)

Note that tanks storing inorganic materials such as hydrochloric acid were eliminated from the MACT floor determination. Typically, tanks storing inorganic materials require different control technologies than organic materials (e.g., scrubbers versus condensers). Also, to be consistent with classes of tanks covered by the HON, the EPA did not request data on tanks with capacities less than 10,000 gal or tanks storing materials with a total HAP content less than 5 percent by weight. Thus, tanks with reported characteristics which did not meet the minimum criteria were eliminated from the MACT floor determination.

The storage tank population has been reduced by 69 tanks since the prior MACT floor determination (September 17, 1998). The reduction in the storage tank population is primarily due to the exclusion of tanks which reported a blank value for the weight percent of HAP in the stored material. Additional reductions occurred from the exclusion of tanks storing materials with a total HAP content less than 5 percent by weight and tanks storing inorganic materials.

4.0 WASTEWATER MACT FLOOR DETERMINATION

The existing source MACT floor for wastewater streams generated by MON surface coating manufacturing facilities was determined to be the same control requirements as the HON existing source MACT for wastewater. Control requirements to meet the HON existing source MACT includes several options. Floor control requirements can be met using a steam stripper meeting a minimum set of design specifications. Another option is to use a control device capable of meeting HAP-specific mass fraction removal (Fr) efficiency as specified in Table 9 of the HON rule (40 CFR 63, Subpart G). Therefore, HON control requirements apply to each individual wastewater stream with a VOHAP concentration of 4,000 ppmw or more and a flow rate of 22,000 gal/yr or more.

The affected wastewater stream population used in the MACT floor determination is described in Section 4.1. In Section 4.2, the MACT floor level of performance is described. Section 4.3 describes the MACT floor determinations.

4.1 Affected Wastewater Stream Population

All wastewater streams generated from surface coating manufacturing processes were considered. Wastewater streams containing inorganic materials such as hydrochloric acid and chromium compounds were eliminated from the MACT floor determination. Wastewater streams containing inorganic materials were eliminated from the analysis because inorganic compounds typically require different control technologies than organic materials (e.g., neutralization/chemical precipitation versus steam stripping). The EPA also did not request data on wastewater streams containing HAP concentrations less than 1,000 ppmw. Thus, wastewater streams reporting HAP concentrations less than 1,000 ppmw were also eliminated from the floor analysis. The wastewater stream population that results after these exclusions is 10 streams generated by 9 facilities.

The wastewater stream population has been reduced by 24 streams since the prior MACT floor determination (September 17, 1998). Through telephone conversations with personnel at facilities generating wastewater, additional information was obtained to clarify reported wastewater stream characteristics. Wastewater streams were removed from the MACT floor analysis for the following reasons:

- Streams were actually generated by chemical manufacturing processes instead of a surface coating manufacturing process,
- Reported HAP concentrations were revised,
- Total HAP concentration in wastewater was less than 1,000 ppmw, and
- Streams exclusively contained inorganic compounds.

4.2 MACT Floor Level of Performance

The selected MACT floor level of performance is a wastewater stream treated with the same controls as required by the HON. In general, the HON performance level is that achieved by a steam stripper meeting minimum design specifications or other device capable of meeting HAP-specific mass fraction removal (Fr) efficiencies. Fifty percent of the 10 wastewater streams generated from surface coating manufacturing processes are reportedly treated in a combustion device at an off-site location. These controlled wastewater streams are also characterized as a hazardous waste under the Resource Conservation and Recovery Act (RCRA).

The EPA did not request data on the efficiency of wastewater control devices. However, general engineering design knowledge of the listed treatment technologies and the applicability of the air emission standards for RCRA treatment facilities (40 CFR 264, subparts AA, BB, and CC) supports a VOHAP emissions reduction equivalent to the HON requirements. Since a combustion device is capable of achieving a HON equivalent VOHAP reduction, a MACT floor performance level equivalent to the HON exists for wastewater streams.

4.3 MACT Floor Determinations

The measure of performance for wastewater streams is based on two characteristics: wastewater HAP concentration (ppmw), and wastewater flow rate (gal/min). Wastewater streams with MACT floor equivalent controls and low HAP concentrations and low flow rates are considered more stringent than similar wastewater streams with higher HAP concentrations and higher flow rates. The top performing streams were determined by rank ordering individual wastewater streams in following sequence:

- Level of control equivalent to the existing MACT floor for HON wastewater,
- Total HAP concentration in wastewater, ppmw (ascending order), and
- Total wastewater flow rate, gal/min (ascending order).

Since there are less than 30 reported wastewater streams, the MACT floor is represented by the 5 top performing streams. The 5 top performing wastewater streams are all reportedly treated in combustion device as a RCRA waste at an off-site location. For the top performing streams, the HAP concentration and flow rates ranged from 1,600 ppmw to 100,000 ppmw, and 880 gal/yr to 22,000 gal/yr, respectively.

The “central tendency” of the top performing wastewater streams can be expressed numerically as a median or mean of the performance values. The median performance level for the top wastewater streams corresponds to the wastewater stream with a HAP concentration of 4,000 ppmw and a flow rate of 22,000 gal/yr. While, the average performance level for the top wastewater streams is a flow-weighted average HAP concentration of approximately 15,000 ppmw (15,754 ppmw) and an average flow rate of approximately 10,000 gal/yr (10,630 gal/yr). It was determined that the median performance level represented better the “central tendency” of the top facilities. Since the wastewater HAP concentrations and flow rates for the top performing facilities represented a skewed population distribution, it was determined that characteristics corresponding to the median performance level best represents the central tendency of the data set. Attachment D provides a complete MACT floor listing with corresponding wastewater HAP concentrations (ppmw) and flow rates (gal/min).

5.0 EQUIPMENT COMPONENT FLOOR DETERMINATION

The MACT floor for equipment components was determined to be a monthly sensory leak detection and repair (LDAR) program equivalent to the bulk gasoline terminal NESHAP. The affected source population used in the MACT floor determination is described in Section 5.1. In Section 5.2, the MACT floor level of performance is described. While, Section 5.3 describes the MACT floor determinations.

5.1 Affected Source Population

Equipment components associated with facilities operating surface coating manufacturing processes were considered as the affected source. The affected source population corresponds to the number of facilities that responded to the LDAR component of the EPA survey, 117 facilities.

5.2 MACT Floor Level of Performance

The selected MACT floor level of performance is a structured leak detection and repair (LDAR) program for equipment components. Approximately 42 percent (49) of the surface coating manufacturing processes reportedly have LDAR programs. Several LDAR program characteristics such as leak detection method, leak definition, and inspection frequency are used as the measure of performance to rank order and determine the best performing facility. In general, LDAR programs following EPA reference Method 21 using a portable organic vapor analyzer (OVA) are considered more stringent methods than sensory detection methods (i.e., audible, visual, or olfactory). Also, LDAR programs based on smaller leak definitions (e.g., 500 ppmv or 1,000 ppmv above background concentrations) and more frequent equipment inspections (e.g., monthly or quarterly) are considered more stringent options than LDAR programs using higher leak definitions and less frequent inspections. Facilities implementing LDAR programs detecting leaks with OVA’s, applying smaller leak definitions, and more frequent equipment inspections are considered the better performing sources.

5.3 MACT Floor Determinations

The top performing 12 percent of facilities were determined by rank ordering all facilities by LDAR program characteristics in following sequence:

- Detection method: Method 21, and sensory procedures.
- Inspection frequency: daily, weekly, monthly, quarterly, and annually.
- Leak definition above background concentrations: 500 ppmv, 1,000 ppmv, 10,000 ppmv, and sensory observation.

The top 12 percent of the 127 facilities corresponds to the top 15 facilities. One facility, PPG Industries in Oak Creek, WI, reportedly has a facility-wide LDAR program using an OVA, a leak definition of 10,000 ppmv, and various inspection frequencies (monthly, quarterly, and annually) corresponding to different equipment components. The next 14 ranked facilities are reportedly using a monthly sensory observation LDAR program. Characteristics of the reported monthly sensory LDAR programs were considered equivalent to LDAR characteristics of the bulk gasoline terminal NESHAP. Thus, the "central tendency" of the top performing facilities is clearly a monthly sensory LDAR program equivalent to the bulk gasoline terminal NESHAP.

ATTACHMENT A

MACT FLOOR RANKING FOR PORTABLE PROCESS TANKS/VESSELS

TABLE A: FLOOR FOR SURFACE COATING "PORTABLE" PROCESS TANKS/VESSELS

TOTAL NO. OF TANKS: 3,011

TOP 12 % OF TANKS: 361

Facility	Number of Tanks	Total Number of Tanks	Cover and Type	Control Device	Control Efficiency (Percent)
PPG Industries, Inc. - Springdale Paint Plant	15	15	Yes-Removable	Baghouse/thermal oxidizer	99
BASF Corporation - Belvidere	72	87	Yes-Fixed	T.O.	95
Daniel Products Company, Inc.	21	108	Yes-Removable	Carbon adsorber	85
PPG Industries, Inc. - Cleveland, OH	200	308	Yes-Removable	None	0
PPG Industries, Inc. - Springdale Paint Plant	146	454	Yes-Fixed	None	0
Coronado Paint Company	115	569	Yes-Removable	None	0
PPG Industries, Inc. - Oak Creek, WI	106	675	Yes-Fixed	None	0
Decatur Coatings Facility	100	775	Yes - with "shower cap"	None	0
Red Spot Paint & Varnish Company, Inc.	95	870	YES-REM	N/A	0
Red Spot Westland, Inc.	90	960	YES-REM	N/A	0
Akzo Nobel Coatings Inc.	87	1,047	Yes-Removable	None	0
Devoe Coatings Company	85	1,132	Y/R	None	0
PPG Industries, Inc. - Delaware Paint Plant	80	1,212	Yes-Removable	None	0
PPG Industries, Inc. - Oak Creek, WI	73	1,285	Yes-Removable	None	0

Facility	Number of Tanks	Total Number of Tanks	Cover and Type	Control Device	Control Efficiency (Percent)
Akzo Nobel Coatings Inc.	70	1,355	Yes-Removable	None	0
Akzo Nobel Coatings Inc.	69	1,424	Yes-Removable	None	0
BONDO/MAR-HYDE CORPORATION	68	1,492	Yes-Removable	None	0
BASF Corporation	65	1,557	Yes-Removable	None	0
Sigma Coatings USA B.V.	62	1,619	Yes-Removable	None	0
Morton Automotive Coatings	59	1,678	YES-REM	NO	0
AKZO NOBEL COATINGS INC. - Car Refinish	59	1,737	Yes-Removable	None	0
Red Spot Paint & Varnish Company, Inc.	54	1,791	YES-FIXED	N/A	0
Morton International, Batavia Facility	50	1,841	Yes-Removable	None	0
Akzo Nobel Coatings Inc.	46	1,887	YES-REM	NA	0
Lilly Industries, Inc. - Moline	44	1,931	YES-REM	N/A	0
Peerless Coatings, Inc.	39	1,970	Yes-Removable	No	0
Lilly Industries (USA), Inc.	38	2,008	Yes-Removable	None	0
Akzo Nobel Coatings, Inc.	38	2,046	YES-REM	NA	0
Iowa Paint Manufacturing Company, Inc.	36	2,082	Yes-Removable	None	0
DuPont Mt. Clemens Plant	29	2,111	Yes-Fixed	None	0
SUN CHEMICAL SPECIALTY INKS	27	2,138	Yes-Removable	None	0
Sherwin-Williams Diversified Brands Bedford Ht	27	2,165	Yes-Removable	None	0

Facility	Number of Tanks	Total Number of Tanks	Cover and Type	Control Device	Control Efficiency (Percent)
Coronado Paint Company	25	2,190	Yes-Fixed	None	0
Diamond Vogel-North Inc.	24	2,214	Yes-Removable	None	0
AKZO NOBEL COATINGS INC.	24	2,238	Yes-Removable	None	0
Akzo Nobel Coatings, Inc.	24	2,262	YES-REM	COVERS	0
Courtaulds Coating - Houston	24	2,286	Yes-Removable	None	0
Gemini Coatings, Inc.	23	2,309	Yes-Removable	None	0
Chemcraft International Inc.	22	2,331	Yes-Removable	None	0
Red Spot Westland, Inc.	21	2,352	YES-FIXED	N/A	0
Federated Paint Mfg. Co. Inc.	20	2,372	Yes-Removable	None	0
Sun Chemical, GPI DIV- Northlake	20	2,392	Yes-Removable	None	0
Finnaren & Haley, Inc.	20	2,412	YES-REM	NA	0
Sherwin-Williams Columbus	17	2,429	Yes-Removable	None	0
Lilly Industries (USA), Inc.	17	2,446	Yes-Removable	None	0
SUN CHEMICAL SPECIALTY INKS	16	2,462	Yes-Removable	None	0
THE P.D. GEORGE COMPANY	15	2,477	Yes-Removable	None	0
Aexcel Corporation	15	2,492	YES-Removable	None	0
Valspar Coatings - Pittsburgh	15	2,507	YES-REM	None	0
Lenmar Inc.	14	2,521	Yes-Removable	None	0

Facility	Number of Tanks	Total Number of Tanks	Cover and Type	Control Device	Control Efficiency (Percent)
TNEMEC COMPANY INCORPORATED	13	2,534	Yes-Removable	None	0
BONDO/MAR-HYDE CORPORATION	13	2,547	Yes-Removable	None	0
Keeler & Long Inc.	13	2,560	yes-rem	None	0
Sherwin-Williams Greensboro	12	2,572	Yes-Removable	None	0
Forrest Paint Co.	12	2,584	Yes-Removable	None	0
Saegertown Operations	12	2,596	YES-REM	None	0
Lilly Industries (USA), Inc.	12	2,608	Yes-Removable	None	0
AKZO NOBEL COATINGS INC.	11	2,619	Yes-Removable	None	0
PPG Industries, Inc. - East Point, GA	10	2,629	Yes-Removable	None	0
Lilly Industries (USA), Inc.	10	2,639	Yes-Removable	None	0
BASF Corporation - Belvidere	10	2,649	Yes-Fixed	CV, FA	0
Sheboygan Paint Company	10	2,659	Yes-Removable	None	0
Torrance Coatings and Resins Plant	8	2,667	YES-Removable	None	0
Sherwin-Williams Diversified Brands Greensboro	8	2,675	Yes-Removable	None	0
Penn Color Inc. - Doylestown	8	2,683	Y-Removable	None	0
Tnemec Company Incorporated	7	2,690	YES-REM	N/A	0
Lilly Industries (USA), Inc.	7	2,697	Yes-Removable	None	0
AKZO NOBEL COATINGS INC.	7	2,704	Yes-Removable	None	0

Facility	Number of Tanks	Total Number of Tanks	Cover and Type	Control Device	Control Efficiency (Percent)
Sun Chemical, GPI DIV- Northlake	6	2,710	Yes-Fixed	N/A	0
Valspar Coatings	6	2,716	YES-REM	NA	0
The Valspar Corporation	5	2,721	Yes-Removable	None	0
The Glidden Company Reading Plant	5	2,726	Yes-Removable	None	0
Lilly Industries (USA), Inc.	5	2,731	Yes-Fixed	None	0
SUN CHEMICAL SPECIALTY INKS	5	2,736	Yes-Removable	None	0
Valspar Coatings	5	2,741	YES/REM	NA	0
Berkley Products Company	5	2,746	Yes-Removable	None	0
Keeler & Long Inc.	4	2,750	yes/rem	None	0
Dexter Packaging Products, Birmingham	4	2,754	Yes-Removable	None	0
Sherwin-Williams Baltimore	4	2,758	Yes-Removable	None	0
RBH Dispersions	4	2,762	Yes-Removable	None	0
Lilly Industries (USA), Inc.	3	2,765	Yes-Removable	None	0
Potter Paint Co., Inc.	3	2,768	Yes-Removable	None	0
Sherwin-Williams Automotive Finishes Corporati	3	2,771	Yes-Fixed	None	0
W.M. Barr and Company	2	2,773	YES-FIXED	NA	0
James B. Day & Co.	2	2,775	Yes-Removable	None	0
TNEMEC COMPANY INCORPORATED	2	2,777	Yes-Removable	None	0

Facility	Number of Tanks	Total Number of Tanks	Cover and Type	Control Device	Control Efficiency (Percent)
Sherwin-Williams Automotive Finishes Corporati	1	2,778	Yes-Removable	None	0
Sherwin-Williams Andover	1	2,779	Yes-Removable	None	0
Spraylat Corporation - Los Angeles	1	2,780	Yes-Removable	None	0
Spraylat Corporation - Los Angeles	1	2,781	Yes-Fix	None	0
Lilly Industries, Inc.	1	2,782	YES-REM	N/A	0
Franklin International - Construction Division	1	2,783	Yes-Removable	None	0
Valspar Coatings - Garland	50	2,833	NO	NA	0
Carboline Lake Charles Plant	44	2,877	No	None	0
Carboline-xenia	34	2,911	NO	N/A	0
AKZO NOBEL COATINGS INC.	33	2,944	No	None	0
Akzo Nobel Coatings	25	2,969	NO	None	0
AKZO NOBEL COATINGS, INC.	12	2,981	No	None	0
The Glidden Company	10	2,991	No	None	0
Valspar Coatings - Ft. Wayne	9	3,000	NO	NO	0
WILKO PAINT, INC.	6	3,006	No	None	0
Lilly Industries (USA), Inc.	5	3,011	No	None	0

ATTACHMENT B

MACT FLOOR RANKING FOR STATIONARY PROCESS TANKS/VESSELS

TABLE B: FLOOR FOR SURFACE COATING "STATIONARY" PROCESS TANKS/VESSELS

TOTAL NO. OF TANKS: 4,628

TOP 12 % OF TANKS: 555

Facility	Number of Tanks	Total Number of Tanks	Cover and Type	Control Device	Control Efficiency (Percent)	Avg Control Efficiency (Percent)
PPG Industries, Inc. - Springdale Paint Plant	16	16	Yes-Fixed	Baghouse/thermal oxidizer	99	99.0
Dexter Aerospace Materials	2	18	Yes-Fixed	Oxidizer	99	98.9
BASF Corporation	3	21	Yes-Removable	CA	95	98.4
BASF Corporation - Belvidere	84	105	Yes-Fixed	T.O.	95	95.7
CYTEC ENGINEERED MATERIALS INC.	3	108	Yes-Fixed	CONDENSER	95	95.7
CYTEC ENGINEERED MATERIALS INC.	1	109	Yes-Removable	CONDENSER	95	95.7
DuPont Mt. Clemens Plant	29	138	Yes-Fixed	AB	95	95.5
Morton-West Alexandria, OH	5	143	Yes-Fixed	Regenerative thermal oxidi	95	95.5
Sherwin-Williams Columbus	30	173	Yes-Fixed	Zeolite canister	95	95.4
Morton-West Alexandria, OH	2	175	Yes-Fixed	Dry ice chilled condenser	90	95.3
RBH Dispersions	1	176	Yes-Removable	VACUUM CONDENSER	90	95.3
CYTEC ENGINEERED MATERIALS INC.	2	178	Yes-Fixed	CONDENSER	85	95.2
Daniel Products Company, Inc.	14	192	Yes-Removable	Carbon adsorber	85	94.5
IPS Corporation	10	202	yes/fixed	Cond.	85	94.0

Facility	Number of Tanks	Total Number of Tanks	Cover and Type	Control Device	Control Efficiency (Percent)	Avg Control Efficiency (Percent)
TNEMEC COMPANY INCORPORATED	9	211	Yes-Removable	Condensor	85	93.6
PIERCE & STEVENS CORPORATION	4	215	Yes-Fixed	CONDENSOR	81	93.4
Pierce & Stevens Corporation, Buffalo	2	217	Yes-Fixed	condensor	81	93.3
PPG Industries, Inc. - Cleveland, OH	65	282	Yes-Fixed	Thermal oxidizer	80	90.3
PPG Industries, Inc. - Cleveland, OH	48	330	Yes-Removable	Thermal oxidizer	80	88.8
Carboline-xenia	7	337	YES-FIXED	cond. (EXP.)	80	88.6
Cytec Engineered Materials Inc, Anaheim Facility	5	342	Yes-Removable	Condensor	80	88.5
Morton-West Alexandria, OH	1	343	Yes-Fixed	Condenser	75	88.5
Du Pont - Fort Madison Plant	8	351	Yes/Fixed	Brine Chiller	65	87.9
Franklin International - Construction Division	13	364	Yes-Fixed	Condenser	50	86.6
Ashland, OH Specialty Polymers & Adhesives	1	365	Yes-Fixed	Condenser	28	86.4
Siegwerk Inc. - Lynchburg Facility	3	368	Yes-rem.	Condensor	2	85.7
3M Springfield	19	387	Yes-Removable	None	0	81.5
Aexcel Corporation	36	423	Yes-Fixed	None	0	74.6
Akzo Nobel Coatings	23	446	Yes-Fixed	None	0	70.7
AKZO NOBEL COATINGS INC.	15	461	Yes-Fixed	None	0	68.4
AKZO NOBEL COATINGS INC.	70	531	Yes-Fixed	None	0	59.4
Akzo Nobel Coatings Inc.	44	575	Yes-Fixed	None	0	54.9

Facility	Number of Tanks	Total Number of Tanks	Cover and Type	Control Device	Control Efficiency (Percent)	Avg Control Efficiency (Percent)
Akzo Nobel Coatings Inc.	37	612	Yes-Fixed	None	0	51.6
Akzo Nobel Coatings Inc.	12	624	Yes-Removable	None	0	50.6
Akzo Nobel Coatings Inc.	16	640	YES-REM	NA	0	49.3
Akzo Nobel Coatings Inc.	5	645	Yes-Fixed	NONE	0	48.9
AKZO NOBEL COATINGS INC.	8	653	Yes-Removable	None	0	48.3
Akzo Nobel Coatings Inc.	47	700	Yes-Fixed	None	0	45.1
Akzo Nobel Coatings Inc.	30	730	YES-FIXED	NA	0	43.2
AKZO NOBEL COATINGS INC. - Car Refinish	1	731	Yes-Removable	None	0	43.2
AKZO NOBEL COATINGS INC. - Car Refinish	41	772	Yes-Fixed	None	0	40.9
Akzo Nobel Coatings, Inc.	28	800	YES-FIXED	COVERS	0	39.4
AKZO NOBEL COATINGS, INC.	2	802	Yes-Removable	None	0	39.3
Akzo Nobel Coatings, Inc.	7	809	YES-FIXED	NA	0	39.0
Akzo Nobel Coatings, Inc.	2	811	YES-REM	NA	0	38.9
Ashland, OH Specialty Polymers & Adhesives	12	823	Yes-Fixed	None	0	38.3
BASF Corporation	56	879	Yes-Removable	None	0	35.9
BASF Corporation	54	933	Yes-Fixed	None	0	33.8
Benco Sales, Inc.	3	936	Yes-Removable	None	0	33.7
BONDO/MAR-HYDE CORPORATION	3	939	Yes-Fixed	None	0	33.6

Facility	Number of Tanks	Total Number of Tanks	Cover and Type	Control Device	Control Efficiency (Percent)	Avg Control Efficiency (Percent)
BONDO/MAR-HYDE CORPORATION	15	954	Yes-Removable	None	0	33.1
Carboline Lake Charles Plant	9	963	Yes-Removable	None	0	32.8
Carboline Lake Charles Plant	2	965	No	None	0	32.7
Carboline Lake Charles Plant	1	966	Yes-Fixed	None	0	32.7
CARLISLE SYNTEC INCORPORATED - Plant	3	969	Yes-Fixed	None	0	32.6
Chemcraft International Inc.	11	980	Yes-Fixed	None	0	32.2
Chemcraft International Inc.	2	982	Yes-Removable	None	0	32.1
Childers Products Company, Inc.	3	985	Yes-Removable	None	0	32.0
Clifton Adhesive, Inc.	9	994	Yes-Removable	None	0	31.7
Coronado Paint Company	15	1,009	Yes-Removable	None	0	31.3
Courtaulds Coating - Houston	57	1,066	Yes-Fixed	None	0	29.6
Courtaulds Coatings Plant One (Porter Paints)	20	1,086	NO	NO	0	29.1
Courtaulds Coatings Plant One (Porter Paints)	51	1,137	YES-FIXED	NO	0	27.7
Decatur Coatings Facility	2	1,139	Yes-Fixed	None	0	27.7
Decatur Coatings Facility	6	1,145	No	None	0	27.6
Decatur Coatings Facility	30	1,175	Yes-Removable	None	0	26.9
Devoe Coatings Company	8	1,183	Y/R	None	0	26.7
Dexter Packaging Products, Birmingham	2	1,185	Yes-Fixed	None	0	26.6

Facility	Number of Tanks	Total Number of Tanks	Cover and Type	Control Device	Control Efficiency (Percent)	Avg Control Efficiency (Percent)
Dexter Packaging Products, Birmingham	7	1,192	Yes-Removable	Condensor	0	26.5
Dexter Packaging Products, Birmingham	24	1,216	Yes-Removable	None	0	25.9
Dexter Packaging Products, Birmingham	2	1,218	Yes-Removable	Carbon	0	25.9
Dexter Packaging Products, Birmingham	3	1,221	Yes-Fixed	Condensor	0	25.8
Dexter Packaging Products, Birmingham	1	1,222	Yes-Fixed	Carbon Drum	0	25.8
Diamond Vogel-North Inc.	3	1,225	Yes-Fixed	None	0	25.8
Du Pont - Fort Madison Plant	126	1,351	Yes/Fixed	None	0	23.4
DUPONT FRONT ROYAL SITE	59	1,410	YES / F	None	0	22.4
DUPONT FRONT ROYAL SITE	2	1,412	YES /F	None	0	22.3
DUPONT FRONT ROYAL SITE	11	1,423	YES-Fixed	None	0	22.2
DuPont Mt. Clemens Plant	153	1,576	Yes-Fixed	None	0	20.0
Federated Paint Mfg. Co. Inc.	11	1,587	Yes-Fixed	None	0	19.9
Finnaren & Haley, Inc.	11	1,598	YES-FIXED	None	0	19.7
Finnaren & Haley, Inc.	1	1,599	YES-HINGED	NA	0	19.7
Finnaren & Haley, Inc.	3	1,602	YES/HINGED	NA	0	19.7
Finnaren & Haley, Inc.	2	1,604	YES-DOMED	NA	0	19.7
FLINT INK CORPORATION	7	1,611	YES-FIXED	None	0	19.6
Flint Ink Corporation	31	1,642	Yes-Fixed	None	0	19.2

Facility	Number of Tanks	Total Number of Tanks	Cover and Type	Control Device	Control Efficiency (Percent)	Avg Control Efficiency (Percent)
Franklin International - Construction Division	6	1,648	Yes-Fixed	None	0	19.1
Gage Products Company	1	1,649	Yes-Removable	None	0	19.1
Gage Products Company	13	1,662	Yes-Fixed	None	0	19.0
Gemini Coatings, Inc.	16	1,678	Yes-Fixed	None	0	18.8
ICI Paints - Sinclair	48	1,726	YES-REM	NA	0	18.3
INK SOURCE	1	1,727	NO	None	0	18.3
Iowa Paint Manufacturing Company, Inc.	21	1,748	Yes-Fixed	None	0	18.0
Iowa Paint Manufacturing Company, Inc.	7	1,755	Yes-Removable	None	0	18.0
IPS Corporation	7	1,762	yes/fixed	N/A	0	17.9
James B. Day & Co.	7	1,769	Yes-Fixed	None	0	17.8
James B. Day & Co.	20	1,789	Yes-Removable	None	0	17.6
Keeler & Long Inc.	7	1,796	yes/fixed	None	0	17.6
Lenmar Inc.	30	1,826	Yes-Removable	None	0	17.3
Lilly Industries (USA), Inc.	64	1,890	Yes-Fixed	None	0	16.7
Lilly Industries (USA), Inc.	63	1,953	Yes-Fixed	None	0	16.2
Lilly Industries (USA), Inc.	11	1,964	Yes-Removable	None	0	16.1
Lilly Industries (USA), Inc.	7	1,971	Yes-Fixed	None	0	16.0
Lilly Industries (USA), Inc.	44	2,015	Yes-Fixed	None	0	15.7

Facility	Number of Tanks	Total Number of Tanks	Cover and Type	Control Device	Control Efficiency (Percent)	Avg Control Efficiency (Percent)
Lilly Industries (USA), Inc.	99	2,114	Yes-Fixed	None	0	14.9
Lilly Industries (USA), Inc.	12	2,126	Yes-Removable	None	0	14.8
Lilly Industries (USA), Inc.	12	2,138	Yes-Removable	None	0	14.8
Lilly Industries (USA), Inc.	2	2,140	Yes-Fixed	None	0	14.7
Lilly Industries, Inc.	5	2,145	YES-REM	N/A	0	14.7
Lilly Industries, Inc. - Moline	38	2,183	YES-FIXED	N/A	0	14.5
Morton Automotive Coatings	59	2,242	YES-FIXED	NO	0	14.1
Morton International Inc. - Ringwood Plant	4	2,246	Yes-Fixed	None	0	14.0
Morton International, Batavia Facility	50	2,296	Yes-Fixed	None	0	13.7
Morton-West Alexandria, OH	9	2,305	Yes-Removable	None	0	13.7
Parks Corporation	4	2,309	Yes-Fixed	None	0	13.7
Pierce & Stevens Corp., Kimberton Facility	2	2,311	Yes-Removable	None	0	13.7
Pierce & Stevens Corp., Kimberton Facility	1	2,312	Yes-Removable	NA	0	13.6
Pierce & Stevens Corporation, Buffalo	25	2,337	Yes-Fixed	None	0	13.5
Potter Paint Co., Inc.	2	2,339	Yes-Removable	None	0	13.5
PPG Industries, Inc. - Cleveland, OH	14	2,353	Yes-Removable	None	0	13.4
PPG Industries, Inc. - Cleveland, OH	14	2,367	Yes-Fixed	None	0	13.3
PPG Industries, Inc. - Delaware Paint Plant	189	2,556	Yes-Fixed	None	0	12.3

Facility	Number of Tanks	Total Number of Tanks	Cover and Type	Control Device	Control Efficiency (Percent)	Avg Control Efficiency (Percent)
PPG Industries, Inc. - Delaware Paint Plant	24	2,580	Yes-Fixed	None	0	12.2
PPG Industries, Inc. - East Point, GA	8	2,588	Yes-Removable	None	0	12.2
PPG Industries, Inc. - East Point, GA	46	2,634	Yes-Removable	None	0	12.0
PPG Industries, Inc. - Oak Creek, WI	138	2,772	Yes-Fixed	None	0	11.4
PPG Industries, Inc. - Oak Creek, WI	33	2,805	Yes-Fixed	None	0	11.2
PPG Industries, Inc. - Springdale Paint Plant	57	2,862	Yes-Fixed	None	0	11.0
RBH Dispersions	5	2,867	Yes-Fixed	None	0	11.0
RBH Dispersions	18	2,885	Yes-Removable	None	0	10.9
RBH Dispersions	2	2,887	No	None	0	10.9
Red Spot Paint & Varnish Company, Inc.	68	2,955	YES-FIXED	N/A	0	10.7
Red Spot Westland, Inc.	15	2,970	YES-FIXED	N/A	0	10.6
Rust-Oleum Corporation - Hagerstown Plant	61	3,031	Yes-Fixed	None	0	10.4
Saegertown Operations	5	3,036	YES-REM	None	0	10.4
Saegertown Operations	8	3,044	YES-FIXED	None	0	10.4
Saegertown Operations	7	3,051	YES-FIXED	None	0	10.3
Sheboygan Paint Company	15	3,066	Yes-fixed	None	0	10.3
Sherwin-Williams Andover	52	3,118	Yes-Removable	None	0	10.1
Sherwin-Williams Automotive Finishes Corporati	149	3,267	Yes-Fixed	None	0	9.7

Facility	Number of Tanks	Total Number of Tanks	Cover and Type	Control Device	Control Efficiency (Percent)	Avg Control Efficiency (Percent)
Sherwin-Williams Baltimore	163	3,430	Yes-Removable	None	0	9.2
Sherwin-Williams Columbus	32	3,462	Yes-Fixed	None	0	9.1
Sherwin-Williams Columbus	7	3,469	Yes-Removable	None	0	9.1
Sherwin-Williams Diversified Brands Bedford Ht	1	3,470	Yes-Fixed	None	0	9.1
Sherwin-Williams Diversified Brands Bedford Ht	10	3,480	Yes-Removable	None	0	9.1
Sherwin-Williams Diversified Brands Greensboro	1	3,481	Yes-Fixed	None	0	9.1
Sherwin-Williams Diversified Brands Greensboro	62	3,543	Yes-Removable	None	0	8.9
Sherwin-Williams Garland	126	3,669	Yes-Removable	None	0	8.6
Sherwin-Williams Greensboro	33	3,702	Yes-Removable	None	0	8.5
Siegwerk Inc. - Lynchburg Facility	21	3,723	Yes-rem.	None	0	8.5
Sigma Coatings USA B.V.	3	3,726	Yes-Removable	None	0	8.5
Sovereign Enginered Adhesives	28	3,754	No	None	0	8.4
Spraylat Corporation - Los Angeles	2	3,756	Yes-Removable	None	0	8.4
Spraylat Corporation - Los Angeles	2	3,758	Yes-Fix	None	0	8.4
Spraylat Corporation - Los Angeles	1	3,759	Yes- Fix	None	0	8.4
Sun Chemical - Clearing Plant	10	3,769	Yes-Fixed	None	0	8.4
Sun Chemical - Clearing Plant	1	3,770	Yes-Fixed	Condensor	0	8.4
Sun Chemical - Dickson	8	3,778	Yes-Removable	None	0	8.4

Facility	Number of Tanks	Total Number of Tanks	Cover and Type	Control Device	Control Efficiency (Percent)	Avg Control Efficiency (Percent)
Sun Chemical - Gallatin	12	3,790	Yes-Removable	None	0	8.3
Sun Chemical - Kankakee	38	3,828	Yes-Fixed	None	0	8.2
Sun Chemical - Reno	12	3,840	Yes-Fixed	None	0	8.2
Sun Chemical - Williamsport	13	3,853	Yes-Fixed	None	0	8.2
SUN CHEMICAL SPECIALTY INKS	1	3,854	Yes-Fixed	None	0	8.2
SUN CHEMICAL SPECIALTY INKS	3	3,857	Yes-Removable	None	0	8.2
SUN CHEMICAL SPECIALTY INKS	1	3,858	Yes-Fixed	None	0	8.2
Sun Chemical, GPI DIV- Northlake	21	3,879	Yes-Fixed	N/A	0	8.1
Sun Chemical, GPI DIV- Northlake	12	3,891	Yes-Removable	None	0	8.1
Surface Coatings, Inc.	24	3,915	Yes-Fixed	None	0	8.1
The Glidden Company	86	4,001	Yes-Fixed	None	0	7.9
The Glidden Company Reading Plant	161	4,162	Yes-Fixed	None	0	7.6
THE P.D. GEORGE COMPANY	10	4,172	Yes-Removable	None	0	7.6
THE P.D. GEORGE COMPANY	18	4,190	Yes-Fixed	None	0	7.5
The RectorSeal Corporation	2	4,192	Yes-Removable	None	0	7.5
The Valspar Corporation	3	4,195	Yes-Fixed	None	0	7.5
The Valspar Corporation	2	4,197	Yes-Fixed	None	0	7.5
TNEMEC COMPANY INCORPORATED	3	4,200	Yes-Removable	None	0	7.5

Facility	Number of Tanks	Total Number of Tanks	Cover and Type	Control Device	Control Efficiency (Percent)	Avg Control Efficiency (Percent)
TNEMEC COMPANY INCORPORATED	17	4,217	Yes-Removable	None	0	7.5
Tnemec Company Incorporated	1	4,218	YES-FIXED	N/A	0	7.5
TNEMEC COMPANY INCORPORATED	10	4,228	Yes-Fixed	None	0	7.5
Torrance Coatings and Resins Plant	5	4,233	Yes-Fixed	None	0	7.5
Torrance Coatings and Resins Plant	18	4,251	Yes-Fixed	None	0	7.4
Valspar Coatings	35	4,286	YES-FIXED	NA	0	7.4
Valspar Coatings	4	4,290	YES-REM	NA	0	7.4
Valspar Coatings	29	4,319	YES/REM	NA	0	7.3
Valspar Coatings - Ft. Wayne	15	4,334	YES-FIXED	None	0	7.3
Valspar Coatings - Ft. Wayne	44	4,378	YES-FIXED	NO	0	7.2
Valspar Coatings - Garland	4	4,382		None	0	7.2
Valspar Coatings - Garland	7	4,389	NO	NA	0	7.2
Valspar Coatings - Garland	50	4,439	YES-REM	NA	0	7.1
Valspar Coatings - Garland	36	4,475	YES-REM	None	0	7.1
Valspar Coatings - kankakee	66	4,541	YES-FIXED	None	0	6.9
Valspar Coatings - Pittsburgh	15	4,556	YES-REM	None	0	6.9
Vogel Paint & Wax Co., Inc.	34	4,590	Yes-Fixed	None	0	6.9
W.M. Barr and Company	38	4,628	YES-FIXED	NA	0	6.8

ATTACHMENT C

MACT FLOOR RANKING FOR STORAGE TANKS

TABLE C: FLOOR FOR SURFACE COATING MANUFACTURING STORAGE TANKS

TOTAL NO. OF TANKS: 453

TOP 12 % OF TANKS: 55

	Plant Name	Tank ID	Tank Description	Control Device	Control Efficiency (percent)	Tank Capacity (gallons)
1	Torrance Coatings and Resins Plant, Torrance, CA	TK117	A,D	Carbon Absorption	90	15,000
2	Torrance Coatings and Resins Plant, Torrance, CA	TK16	A,D	Carbon Absorption	90	20,000
3	Torrance Coatings and Resins Plant, Torrance, CA	TK17	A,D	Carbon Absorption	90	20,000
4	Torrance Coatings and Resins Plant, Torrance, CA	TK60	A,D	Carbon Absorption	90	20,000
5	Torrance Coatings and Resins Plant, Torrance, CA	TK15	A,D	Carbon Absorption	90	25,000
6	Torrance Coatings and Resins Plant, Torrance, CA	TK1	A,D	Carbon Absorption	90	25,000
7	PPG Industries, Inc. - Cleveland, OH, Cleveland, OH	32-T-104	A, D, T	Thermal incinerator	80	10,000
8	PPG Industries, Inc. - Cleveland, OH, Cleveland, OH	32-T-105	A, D, T	Thermal incinerator	80	10,000
9	PPG Industries, Inc. - Cleveland, OH, Cleveland, OH	32-T-110	A, D, T	Thermal incinerator	80	10,000
10	PPG Industries, Inc. - Cleveland, OH, Cleveland, OH	32-T-112	A, D, T	Thermal incinerator	80	10,000

Tank Description Codes:

A=Closed tank vented to a control device
V=Closed tank with vapor balancing
H=Horizontal tank
D=Vertical tank
C=Closed tank with conservation vents
U=Underground tank
T=Constant temperature
O=Other

	Plant Name	Tank ID	Tank Description	Control Device	Control Efficiency (percent)	Tank Capacity (gallons)
11	PPG Industries, Inc. - Cleveland, OH, Cleveland, OH	32-T-111	A, D, T	Thermal incinerator	80	10,000
12	Dexter Packaging Products, Birmingham, Birmingham, AL	13	A, D	Carbon tray	30	12,000
13	Dexter Packaging Products, Birmingham, Birmingham, AL	6	A, D	Carbon tray	30	12,000
14	Dexter Packaging Products, Birmingham, Birmingham, AL	5	A, D	Carbon tray	30	12,000
15	Dexter Packaging Products, Birmingham, Birmingham, AL	25	A, D	Carbon tray	30	12,000
16	Dexter Packaging Products, Birmingham, Birmingham, AL	24	A, D	Carbon tray	30	12,000
17	Dexter Packaging Products, Birmingham, Birmingham, AL	35	A, D	Carbon tray	30	20,000
18	Dexter Packaging Products, Birmingham, Birmingham, AL	31	A, D	Carbon tray	30	30,000

Tank Description Codes:

A=Closed tank vented to a control device
V=Closed tank with vapor balancing
H=Horizontal tank
D=Vertical tank
C=Closed tank with conservation vents
U=Underground tank
T=Constant temperature
O=Other

ATTACHMENT D

MACT FLOOR RANKING FOR WASTEWATER STREAMS

TABLE D: FLOOR FOR SURFACE COATING MANUFACTURING WASTEWATER STREAMS

TOTAL NO. OF STREAMS: 10

FLOOR REPRESENTED BY TOP 5 STREAMS

	Plant Name	Wastewater ID	Flow Rate (gal/yr)	HAP Concentration (ppmw)	Treatment Code
1	Lilly Industries (USA), Inc., Montebello, CA	WW02	880	1,600	*OF-Combustion, RCRA waste
2	Akzo Nobel Coatings Inc., Pontiac, MI	WBP	18,971	2,000	*OF-Combustion, RCRA waste
3	Sherwin-Williams Greensboro, Greensboro, NC	WW1	22,000	4,000	*OF-Combustion, RCRA waste
4	Lilly Industries (USA), Inc., Montebello, CA	WW01	7,000	40,000	*OF-Combustion, RCRA waste
5	Morton-West Alexandria, OH, West Alexandria, O	LF	4,300	100,000	*OF-Combustion, RCRA waste
6	The Glidden Company Reading Plant, Reading, PA	CWW	11,000	1,200	HT, TT, DP
7	Sherwin-Williams Garland, Garland, TX	WW1	500,000	10,000	OF-Landfill solidification
8	PPG Industries, Inc. - East Point, GA, East Point, G	EPXCWLL201	13,500	210,000	TT
9	PPG Industries, Inc. - Oak Creek, WI, Oak Creek,	Tank 1909	357,000	3,000	TT, DP
10	Valspar Coatings - Garland, Garland, TX	Latex	500,000	10,000	TT/DP

Wastewater Treatment Codes:

HT=Holding tank
BI=Biological treatment
CL=Clarifier
SS=Steam stripper
OP=Open pond
EQ=Equalization pond
TT=Treatment tank
OF=Offsite destruction
AS=Air stripper
DP=Discharge to a POTW
O=Other

MEMORANDUM

DATE: August 20, 1999

SUBJECT: National Impacts Associated with Regulatory Options for MON Coatings Manufacturing Processes

FROM: Chuck Zukor
Alpha-Gamma Technologies, Inc.

To: Miscellaneous Organic NESHAP Project File

The purpose of this memorandum is to summarize national impacts associated with regulatory options for MON coatings manufacturing processes. Impacts discussed in this memorandum include HAP emission reductions and control costs associated with each regulatory option. Additional information provided in this memorandum include:

1) Descriptions of the regulatory options,

2) Summary of national impacts resulting from applying each option,

3) Identification of emission control measures selected to meet the required performance level of each regulatory option,

4) Identification of the procedures used to estimate the control costs, and

5) Summary of estimated control costs and emission reductions for each individual affected emission source.

The MACT floor option is estimated to reduce nationwide HAP emissions by approximately 4,000 tons/yr at a total annual cost of $17.3 million/yr. The overall cost effectiveness of the MACT floor regulatory option is approximately $4,400/ton of HAP.

1.0 REGULATORY OPTIONS

A total of six regulatory options were developed to reduce HAP emissions from MON coatings manufacturing processes. The first regulatory option represents the MACT floor level of performance and corresponding applicability criteria for each emission source type (i.e., process vessel, storage tank, equipment components, and wastewater). Table 1 provides a summary of the MACT floor performance levels and control applicability criteria for each emission source type. Table 1 also includes a more stringent, above-the-floor option for each emission source type.

For process vessels and equipment components, the applicability criteria of the MACT floor and above-the-floor options remain the same (i.e., affecting the same number of sources). The performance level of the above-the-floor options are more stringent which result in obtaining higher HAP emission reductions compared to the MACT floor performance levels. For example, the MACT floor performance level for stationary process vessels is a control device with a 60 percent control efficiency. The above-the-floor option is a control device with a 75 percent control efficiency which achieves a larger HAP emission reduction.

For storage tanks and wastewater, the performance level of the MACT floor and above-the-floor options remain the same (i.e., the same percent HAP reduction is required for either option). The applicability criteria of the above-the-floor options are more stringent by requiring the installation of controls on a larger number of sources, thus obtaining higher HAP emission reductions. For example, the MACT floor applicability criteria for wastewater is a flow rate of 22,000 gal/yr or more and a VOHAP concentration of 4,000 ppmw or more.[1] The above-the-floor applicability criteria for wastewater is expanded to capture additional streams with a lower flow rate limit of 880 gal/yr or more and a lower VOHAP concentration limit of 1,600 ppmw or more.

Five additional regulatory options were developed by ranking the above-the-floor requirements by cost effectiveness in ascending order, and then cumulatively replacing the MACT floor control requirement of an emission source type with a more stringent, above-the-floor requirement. For example, Option 1 includes the most cost effective above-the-floor control requirement which is for equipment components, and the MACT floor control requirements for the remaining emission source types. Option 2 includes the two most cost effective above-the-floor requirements (equipment components and storage tanks above floor option 1) and the MACT floor requirements for the remaining emission source types. Finally, Option 5 includes the most stringent above-the-floor requirements for all the emission source types.

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1 VOHAP is described in Table 9 of the HON rule (40 CFR 63, Appendix to Subpart G). Table 9 lists the volatile organic HAP (VOHAP) which volatilize readily from wastewater and are characterized by Henry's Law constants greater than or equal to 1.51×10^{-6} atm-m^3/mol.

Table 1. Regulatory Options by Emission Source Type for Coatings Manufacturing Sources Covered Under the MON

Emission Source Type	Performance Level	Performance Level	Applicability Criteria Requiring the Installation of Controls
Stationary Process Vessels	MACT Floor	Cover and 60 percent reduction	Vessel with capacity $\geq$ 250 gal
	Above-the-Floor	Cover and 75 percent reduction	
Portable Process Vessels	MACT Floor	Cover (assumed 10 percent reduction)	Vessel with capacity $\geq$ 250 gal
	Above-the-Floor	Cover and 75 percent reduction	
Storage Tanks	MACT Floor	Baseline, no control	Tank with capacity $\geq$ 10,000 gal
	Above-the-Floor 1	Internal floating roof or external floating roof or 95 percent reduction	Tank with capacity $\geq$ 10,000 gal and HAP partial pressure $\geq$ 3.0 psia
	Above-the-Floor 2		Tank with capacity $\geq$ 10,000 gal and HAP partial pressure $\geq$ 1.9 psia
Wastewater	MACT Floor	Same reductions as required by the HON	Wastewater flow rate $\geq$ 22,000 gal/yr and total VOHAP[a] $\geq$ 4,000 ppmw.
	Above-the-Floor		Wastewater flow rate $\geq$ 880 gal/yr and total VOHAP[a] $\geq$ 1,600 ppmw.
Equipment Components	MACT Floor	Monthly sensory LDAR program	All affected product processes.
	Above-the-Floor	HON equivalent LDAR program	

[a] VOHAP is described in Table 9 of the HON rule (40 CFR 63, Appendix to Subpart G). Table 9 lists the volatile organic HAP (VOHAP) which volatilize readily from wastewater and are characterized by Henry's Law constants greater than or equal to 1.51×10^{-6} atm-m^3/mol.

Table 2 presents a summary of the national impacts associated with the six regulatory options for MON coatings manufacturing processes. The following primary air impacts and corresponding control costs are presented:

- Baseline HAP emissions (tons/yr) which represent the current emission level for the source category in the absence of any additional regulations,
- Controlled HAP emissions (tons/yr) resulting after applying a regulatory option,
- HAP emission reductions (tons/yr) achieved with each option,
- HAP percent reduction (percent) corresponding to each option,
- Total capital investment of required controls (1999 dollars),
- Total annual costs of operating the required controls (1999 dollars/yr),
- Cost effectiveness ($/ton) of each option, and
- Incremental cost effectiveness ($/ton) between regulatory options.

2.0 NATIONWIDE IMPACTS

Nationwide impacts for MON coatings manufacturing processes are presented relative to a baseline reflecting the current level of control in the absence of any additional regulations. The national impacts for existing sources were estimated by applying the controls necessary to bring each facility into compliance with the proposed regulatory option. For emission points already in compliance with the proposed regulatory option, no impacts were estimated.

2.1 Nationwide Extrapolation of Impacts

Information used in development of the MON was obtained from responses to a Section 114 survey. The Section 114 surveys were distributed to all known sources with MON coatings manufacturing processes. Thus, the estimated impacts for coatings manufacturing processes in the MON database are considered fully representative of the nationwide impacts.

2.2 Primary Air Impacts

Table 3 summarizes the organic HAP emission reductions achieved by each regulatory option for each emission source type. The MACT floor regulatory option is estimated to

Table 2. Impacts Associated with Regulatory Options for Coatings Manufacturing Sources Covered Under the MON

Regulatory Option	Baseline HAP Emissions (tons/yr)	Controlled HAP Emissions (tons/yr)	HAP Emission Reduction (tons/yr)	Percent Reduction (%)	Total Capital Investment ($1,000)	Total Annualized Costs ($1,000/yr)	Cost Effectiveness ($/ton)	Incremental Cost Effectiveness ($/ton)
Baseline	8,583	8,583	0	0	0	0	N/A	N/A
MACT floor		4,614	3,969	46.2	53,455	17,323	4,365	4,365
Option 1		4,213	4,370	50.9	53,699	18,316	4,191	2,476
Option 2		4,206	4,377	51.0	53,755	18,340	4,190	3,315
Option 3		2,653	5,930	69.1	56,796	20,369	3,435	1,307
Option 4		2,646	5,937	69.2	56,941	20,436	3,442	6,478
Option 5[a]		2,646	5,937[a]	69.2	57,380	20,588	3,468	5,073,000

MACT Floor: MACT floor option for all emission source types.
Option 1: MACT floor option plus above-the-floor option for equipment components.
Option 2: MACT floor option plus above-the-floor option for equipment components, and storage tank Above Floor Option 1.
Option 3: MACT floor option plus above-the-floor option for equipment components, storage tank Above Floor Option 1, and process vessels.
Option 4: MACT floor option plus above-the-floor option for equipment components, process vessels, and storage tank Above Floor Option 2.
Option 5: Most stringent above-the-floor option for all emission source types (includes storage tank Above Floor Option 2).
[a] The HAP emission reduction obtained is 0.03 tpy, which is masked by rounding.

Table 3. Summary of HAP Emission Reductions by Emission Point for Existing Coating Manufacturing Sources

Emission Source Type and Regulatory Option	Baseline HAP Emissions (ton/yr)	Controlled HAP Emissions (ton/yr)	HAP Emission Reductions (ton/yr)	Percent Reduction (%)
Process Vessels (Stationary and Portable)				
MACT Floor	7,363	3,660	3,703	50
Above Floor	7,363	2,107	5,256	71
Storage Tanks				
MACT Floor	74	74	0	0
Above Floor Option 1	74	67	7	10
Above Floor Option 2	74	60	14	19
Wastewater				
MACT Floor	11	3	8	74
Above Floor[a]	11	3[a]	8[a]	74
Equipment Leaks				
MACT Floor	1,135	877	258	23
Above Floor	1,135	476	659	58
Total				
MACT Floor	8,583	4,614	3,969	46
Above Floor[b]	8,583	2,646	5,937	69

[a] The HAP emission reduction obtained is 0.03 tpy, which is masked by rounding.
[b] Includes impacts from storage tank Above Floor Option 2.

reduce organic HAP emissions from all existing sources by 4,000 tons/yr from a baseline level of 8,600 tons/yr. The MACT Floor option represents an overall 46 percent reduction. The above-the-floor regulatory option, Option 5, is estimated to reduce the most organic HAP emissions from all existing sources. Option 5 reduces HAP emissions by 6,000 tons/yr which represents a 69 percent HAP emission reduction from the baseline level.

The largest reduction in HAP emissions resulted from the control of MON coatings process vessels, more than 3,700 tons/yr which represents a 50 percent reduction from the process vessel baseline. Emissions from process vessels represent more than 85 percent of the emissions from all coatings manufacturing sources covered by the MON. The next largest reduction in HAP emissions resulted from the control of equipment components, 260 tons/yr which represents a 23 percent reduction from the equipment components baseline. Emissions from equipment components represent approximately 13 percent of the emissions from all coatings manufacturing sources covered by the miscellaneous paint and coatings manufacturing source category.

2.3 Cost Impacts

Cost impacts include the total capital investment of new control equipment, the cost of energy (steam, and electricity) required to operate control equipment, operation and maintenance costs, and the cost savings generated by reducing the loss of valuable product in the form of emissions. Note that the cost impacts currently do not include the costs of monitoring, recordkeeping, and reporting associated with the proposed options. Average cost effectiveness ($/ton of pollutant removed) is also presented as part of the cost impacts and is determined by dividing the total annual costs ($/yr) by the annual HAP emission reduction (tons/yr).

Table 4 presents the estimated total capital investment, total annual costs, and average cost effectiveness for complying with each regulatory option. For the MACT floor option, the estimated total capital investment for existing sources is $53 million in 1999 dollars, and the total annual cost is $17.3 million/yr in 1999 dollars. For Option 5, the most stringent above-the-floor option, the estimated total capital investment for existing sources increases to $57 million in 1999 dollars, and the total annual cost increases to $20.6 million/yr in 1999 dollars.

The actual cost of the impacts for the proposed options may be less than presented because of the potential to combine emission streams and use common control devices, to upgrade existing control devices, and to vent emission streams into current control devices. Because the effect of such practices is highly site-specific and information was unavailable, it is not possible to quantify this overstatement of expected compliance costs.

A tool used to identify a more cost effective control option over others is the incremental cost effectiveness ($/ton HAP). The incremental cost effectiveness is a measure of the cost associated with each additional ton of HAP reduced over a less stringent option. For example, the incremental cost effectiveness for the MACT Floor option compared to the baseline (i.e., no control) is $4,365 /ton HAP. While, the incremental cost effectiveness for Option 1 compared to the MACT Floor option is $2,476/ton HAP. As shown in Table 2, the incremental cost effectiveness for the remaining regulatory options range from $1,300/ton to $5 million/ton.

3.0 EMISSION CONTROL MEASURES AND COSTING PROCEDURES

The estimation of control costs applies only to major existing MON sources. Costs were estimated by applying only those controls necessary to bring each facility into compliance with the proposed regulatory option. For emission points already in compliance with the proposed regulatory option, no costs were estimated. In general, the costing procedures used for the emission control measures are established EPA procedures. A summary of assumed general values used in the control cost estimating procedures are provided in Attachment 1.

Table 4. Summary of Cost Impacts by Emission Point for Existing Coating Manufacturing Sources

Emission Point and Regulatory Option	Total Capital Costs ($1,000)	Total Annual Costs ($1,000/yr)	Cost Effectiveness ($/ton)	
			Average	Incremental
Process Vessels (Stationary and Portable)				
MACT Floor	51,654	16,470	4,448	---
Above Floor	54,695	18,499	3,519	1,307
Storage Vessels				
MACT Floor	0	0	0	---
Above Floor Option 1	56	24	3,315	3,315
Above Floor Option 2[a]	201	91	6,478	6,478
Wastewater				
MACT Floor	1,315	457	56,549	---
Above Floor	1,754	609	75,117	5,073,000
Equipment Leaks				
MACT Floor	486	396	1,535	---
Above Floor	730	1,389	2,109	2,476
Total				
MACT Floor	53,455	17,323	4,365	---
Above Floor[b]	57,380	20,588	3,468	---

[a] Above Floor Option 2 is compared to the storage tank MACT floor option.
[b] Includes impacts from storage tank Above Floor Option 2.

3.1 Process Vessels

Stationary Vessels

Control costs for stationary process vessels are based on the selected control technologies:

- Each vessel equipped with a fixed cover was costed for a refrigerated condenser.
- Each vessel equipped with a removable cover was costed for a carbon adsorption canister system.

Different control technologies were selected to address technical issues associated with fixed covers and removable covers. Fixed covers used by process vessels are generally characterized with sealed or gasketed openings which minimize ambient air and contaminants infiltrating the process vessel. Thus, HAP emissions can be condensed and returned directly to the process vessel for reuse. Removable covers used by process vessels typically include ungasketed holes or openings for protruding process equipment. To prevent HAP emissions from escaping through the ungasketed openings, a minimum facial velocity of 200 ft/min must be maintained across the openings to ensure a 100 percent HAP emission capture efficiency. The minimum facial velocity was obtained from the EPA report, “The Measurement Solution: Using a Temporary Total Enclosure for Capture Efficiency Testing” (EPA 450/4-91-020). Creating the negative draft also significantly dilutes the concentration of HAP in the exhaust stream. Thus, the recovery efficiency of a refrigerated condenser may be reduced to an impractical level and the condenser is likely to condense more water vapor than HAP vapors from the emission stream. A carbon canister adsorption system was selected as a better choice for estimating control costs for process vessels with removable covers.

Approximately two percent of the existing stationary process vessels are reportedly not equipped with a cover. Based on engineering judgement, the total capital investment of a fixed cover including its installation is approximately $4,500 per process vessel.

All vessels equipped with a condenser within a plant are supplied with coolant from a common refrigeration unit. Costs for the MACT floor regulatory option are based on applying refrigerated condensers with a 60 percent HAP reduction efficiency. While, costs for the above-the-floor option are based on applying refrigerated condensers with a 75 percent HAP reduction efficiency. The estimated total capital investment and total annual costs for installing refrigerated condensers with 60 and 75 percent efficiencies are based on procedures provided in EPA’s OAQPS Control Cost Manual (EPA 450/3-90/006). Responses to the Section 114 survey contained limited information necessary to estimate refrigerated condenser costs. Thus, engineering judgement was used to fill data gaps.

For each regulatory option, an oversized refrigeration unit and an oversized condenser was developed for the impacts analysis. Because of the low partial pressures (i.e., <1 psia) and low condensation temperatures (i.e., 8 to 20 ^{o}F) associated with coatings manufacturing solvents, many control device characteristics such as refrigeration capacity (tons) and condenser heat exchange area (ft^2) are near or below listed minimum design limits. Using the minimum design size values allows the control equipment to handle a larger range of anticipated emissions and flow rates.

The selected design of the refrigeration unit is based on removing saturated toluene vapors above a solvent mixture containing 50 percent toluene and 50 percent of a non-volatile material. The maximum continuous flow rate selected for this design scenario is 100 scfm (748 gal/min). Additional characteristics of the design refrigeration unit include:

- MACT floor design (60 percent efficiency): single-stage unit, minimum condensation temperature of 20 ^{o}F, and refrigeration capacity of 0.8 tons.

- Above-the-floor design (95 percent efficiency): single-stage unit, minimum condensation temperature of 8 ^{o}F, and refrigeration capacity of 0.9 tons.

Costs were also developed for additional piping to route coolant from the common refrigeration unit to each condenser. For each condenser, it was assumed that 50 feet of 2-inch, schedule 40 pipe and a valve are required.

Each process vessel with a removable cover and requiring control was costed with a packaged carbon adsorption canister system. Costs for the MACT floor regulatory option are based on applying carbon adsorbers with a 60 percent HAP reduction efficiency. While, costs for the above-the-floor option are based on applying carbon adsorbers with a 75 percent HAP reduction efficiency. The estimated total capital investment and total annual costs for installing packaged carbon adsorption systems are based on vendor quotes and procedures provided in EPA's OAQPS Control Cost Manual (EPA 450/3-90/006).

The selected design of the carbon canister adsorption system is based on costing at least one carbon canister on each applicable process vessel. Additional characteristics of the design carbon adsorption system include:

- Area of all natural draft openings in a removable cover is 1 percent of the total cover area,

- Maximum blower flow rate for each process vessel is 450 scfm with a pressure drop of 4 inches of water,

- HAP adsorptivity on carbon (i.e., equilibrium adsorptivity, W_e, in lb HAP/lb carbon) is determined using the Freundlich equation and the adsorption isotherm parameters for toluene (i.e., k = 0.551 and m = 0.110),

- Working capacity of the carbon, W_c, is assumed one-half the value of the calculated equilibrium adsorptivity, W_e.

- 140 lb of carbon in each canister,

- Additional canisters are added as necessary to maintain a minimum operating period between carbon regeneration of one month, and

Portable Vessels

Control costs for portable process vessels are based on the procedures used for stationary process vessels. The MACT floor costs are based on the application of only a fixed cover on each portable process vessel. Few portable vessels (approximately six percent) are reportedly not equipped with a cover. As with the stationary vessels, the total capital investment of a fixed cover and its installation is assumed as $4,500 per process vessel.

The above-the-floor control costs are based on the application of a cover and a 75 percent efficient control device such as a refrigerated condenser or carbon adsorber on each vessel. The estimated total capital investment and total annual cost procedures for installing a 75 percent efficient control device are the same as the above-the-floor cost procedure for stationary process vessels.

Attachments 2 and 3 provide facility-specific estimated costs and emission reductions associated with the control requirements of the MACT floor and above-the-floor regulatory option (Option 5), respectively. Each attachment presents the combined facility impacts for both stationary and portable process vessels.

3.2 Storage Tanks

The MACT floor for storage tanks associated with MON coatings manufacturing processes is baseline control (i.e., no control). Two above-the-floor options were developed as described in Table 1. Control technologies selected to meet requirements of the above-the-floor options include an internal floating roof (IFR) or a control device capable of achieving a 95 percent reduction in organic HAP emissions. For each vertical storage tank requiring control, costs estimates were developed for an internal floating roof with a liquid-mounted rim seal and controlled deck fittings. The estimated total capital investment and total annual costs for installing an internal floating roof in a storage tank are based on procedures in the HON Background Information Document for Proposed Standards, Volume 1B (EPA-453/D-92-016b).

For each horizontal tank requiring control, a cost estimate was developed for a single, representative refrigerated condenser with a 95 percent HAP reduction efficiency. Procedures provided in EPA's OAQPS Control Cost Manual were used to estimate the total capital investment and total annual costs for the representative refrigerated condenser. Insufficient information to estimate HAP partial pressures of materials stored in tanks led to the development of a model refrigerated condenser. The reported characteristics of MON horizontal tanks associated with coating manufacturing processes are similar to MON horizontal tanks associated with chemical manufacturing processes. In addition, the total capital investment and total annual costs for MON horizontal tanks associated with chemical manufacturing processes varied little from the mean value (i.e., $\pm$ 5 percent). Therefore, it was assumed the average total capital investment and total annual costs for MON horizontal tanks associated with chemical manufacturing processes was representative of MON horizontal tanks associated with coating manufacturing processes.

Attachments 4 and 5 provide tank-specific estimated costs and emission reductions associated with the vertical storage tank control requirements of the Above Floor Option 1 and Above Floor Option 2, respectively. While, Attachments 6 and 7 provide the tank-specific impacts associated with the horizontal storage tank control requirements of the Above Floor Option 1 and Above Floor Option 2, respectively.

3.3 Equipment Leaks

Control costs for leaking equipment components are based on the application of a leak detection and repair (LDAR) program for all MON chemical manufacturing processes. Control costs were developed for two types of LDAR programs. A monthly, sensory LDAR program equivalent to the bulk gasoline terminal NESHAP corresponds to the MACT floor regulatory option. While, a LDAR program equivalent to the HON NESHAP corresponds to the above-the-floor regulatory option.

The algorithms used to develop the LDAR cost estimates are those used to support the equipment leak standards for the amino/phenolic resin NESHAP (Docket Number A-92-19, Item Number II-B-11). These costing algorithms were derived from work used to support the HON equipment leak standards. Variations in the LDAR costs used for MON facilities include:

- In-house personnel rather than subcontracting personnel are assumed to be responsible for implementing the LDAR program,

- Costs associated with using a monitoring instrument are omitted for the sensory LDAR program,
- If necessary, a monitoring instrument is assumed to be rented rather than purchased,
- Facilities subject to either sensory or Method 21 monitoring are assumed to purchase a spreadsheet program for tracking components, and
- Additional personnel training is required for implementing a HON LDAR program (100 hours) compared to a sensory LDAR program (48 hours).

Information necessary to estimate LDAR costs and effectiveness are based on assumed model characteristics. For every 25 process vessels (stationary or portable), the number of equipment components associated with process vessel operations included:

- 30 valves, light-liquid service,
- 6 pumps, light-liquid service,
- 100 flanges,
- 2 open lines, and
- 2 sampling lines.

Additional model equipment characteristics are based on emission rates, leak rates, repair frequencies for various LDAR programs which are documented in the draft Alpha-Gamma report, “Miscellaneous Organic NESHAP - Ranking of Equipment Leak Programs.” Uncontrolled emissions from equipment components were estimated using emission factors associated with the “Batch Baseline” scenario. Emissions resulting from implementation of a monthly, sensory LDAR program were estimated using emission factors for the “Batch SOCMI VV” scenario. Lastly, emissions from a HON LDAR program were estimated using the “Batch HON” emission factors. Attachments 8 and 9 provide facility-specific estimated costs and emission reductions associated with the LDAR requirements of the MACT floor and above-the-floor regulatory options, respectively.

3.4 Wastewater Collection and Treatment

The control technology most suitable for achieving the required organic HAP reductions from process wastewater streams is steam stripping. All wastewater streams requiring control within a facility were combined and a single steam stripper was costed. The steam stripper design characteristics are the same as those used to support development of the HON wastewater standards. The estimated total capital investment and total annual costs for installing a stainless steel steam stripper are based on the cost algorithms presented in the HON Background Information Document for proposed standards, Volume 1B (EPA 453/D-92-016b). Characteristics of wastewater streams associated with MON coatings manufacturing processes were obtained from responses to a Section 114 survey. Facility-specific estimated costs and emission reductions associated with the wastewater control requirements of the MACT floor and above-the-floor regulatory option are provided in Attachments 10 and 11, respectively.

ATTACHMENT 1

Assumed General Values Used in the Control Cost Estimating Procedures

Table A-1. Assumed General Values Used in the Control Cost Estimating Procedures

Description	Value
Cost of electricity	\$0.059 /kw-hr
Cost of steam	\$6.00 /1,000 lb
Cost of technical labor	\$12.96/hr
Cost of maintenance labor	\$14.26/hr
Capital recovery factor, 7% @ 15 years	0.1098
Default hours of operation	8,760 hr/yr
Reference temperature, T_{ref}	68 ^oF
Emission stream temperature, T_e	90 ^oF
Default mean molecular weight of emission stream, MW_e	100 lb/lb mol
Default process vessel vent flow rate, Q_e	100 scfm
Molecular weight of flue gas	29 lb/lb mol
Specific volume of ideal gas at 68 ^oF	385 ft^3/lb mol

ATTACHMENT 2

Estimated Impacts Associated with Process Vessel Control Requirements of the MACT Floor Regulatory Option

Coating Mfg. Process Vessels (MACT Floor)

	Facility #	Portable or Stationary	Uncontrolled HAP Emissions (lb/yr)	Vessel Count	Cover Count	Condenser Count	Carbon Required (lb/mo)	MACT	Flow Rate (scfm)	Baseline HAP Emissions (lb/yr)	MACT Floor HAP Reduction (lb/yr)	MACT Floor TCI ($)	MACT Floor TAC ($/yr)	MACT Floor CE ($/ton)	Control Technology
1	1	S	669,883	7	0	7	0	No	707	602,894	334,941	$77,050	$13,788	$82	Condenser
2	4	P	1,843	1	0	0	0	Yes	25	1,659	0	$0	$0	$0	None
3	4	S	88,457	19	0	19	0	No	801	50,126	7,371	$178,040	$61,673	$16,733	Condenser
4	5	S	12,734	4	0	0	0	Yes	308	2,420	0	$0	$0	$0	None
5	6	S	37,502	1	1	1	0	No	25	37,502	18,751	$31,026	$38,513	$4,108	Condenser
6	9	S	10,500	2	0	0	2,537	No	78	9,450	5,250	$36,254	$25,555	$9,735	Adsorber
7	10	P	8,504	44	44	0	0	No	1,478	8,504	850	$196,733	$29,471	$69,314	Cover
8	10	S	958	2	2	2	0	No	114	958	479	$43,913	$42,270	$176,464	Condenser
9	10	S	4,791	1	0	1	0	No	265	4,312	2,395	$26,555	$39,478	$32,962	Condenser
10	10	S	4,312	9	0	0	1,413	No	513	3,881	2,156	$38,627	$17,205	$15,961	Adsorber
11	13	S	22,358	8	0	0	6,239	No	616	20,122	11,179	$92,801	$63,586	$11,376	Adsorber
12	14	S	469,515	12	0	0	99,206	No	1,032	422,564	234,758	$1,205,470	$966,744	$8,236	Adsorber
13	15	S	305,291	38	0	38	0	No	2,566	274,762	152,646	$337,940	$71,099	$932	Condenser
14	16	P	5,229	6	0	0	0	Yes	382	4,706	0	$0	$0	$0	None
15	16	P	3,565	20	0	0	0	Yes	500	3,209	0	$0	$0	$0	None
16	16	S	8,200	21	0	21	0	No	835	7,380	4,100	$194,871	$64,522	$31,473	Condenser
17	16	S	3,565	12	0	0	1,159	No	392	3,209	1,783	$47,629	$16,483	$18,492	Adsorber
18	17	S	97,021	12	0	12	0	No	620	87,319	48,510	$119,129	$48,734	$2,009	Condenser
19	21	S	98,915	13	0	13	0	No	781	89,023	49,457	$127,545	$49,900	$2,018	Condenser
20	29	P	842	4	0	0	0	Yes	156	757	0	$0	$0	$0	None
21	29	S	9,818	6	0	6	0	No	782	8,836	4,909	$68,634	$45,531	$18,550	Condenser
22	29	S	45,197	33	0	0	14,235	No	3,743	40,677	22,599	$243,473	$150,864	$13,352	Adsorber
23	32	S	15,529	28	28	28	0	No	900	15,529	7,764	$378,975	$91,734	$23,629	Condenser
24	34	S	44,895	25	0	25	0	No	1,127	40,406	22,448	$228,534	$67,730	$6,034	Condenser
25	34	S	8,718	2	0	0	0	Yes	154	1,656	0	$0	$0	$0	None
26	39	P	38,306	80	0	0	0	Yes	2,000	34,476	0	$0	$0	$0	None
27	39	S	699,568	213	0	213	0	No	15,799	629,611	349,784	$1,810,705	$272,005	$1,555	Condenser
28	40	P	1,366	8	0	0	0	Yes	270	1,230	0	$0	$0	$0	None
29	40	S	23,963	23	0	23	0	No	2,183	21,567	11,982	$211,703	$66,255	$11,060	Condenser
30	41	P	1,442	10	0	0	0	Yes	250	1,298	0	$0	$0	$0	None
31	41	S	59,210	54	0	0	18,394	No	4,326	53,289	29,605	$340,404	$198,574	$13,415	Adsorber
32	42	P	56,970	200	0	0	0	Yes	5,000	51,273	0	$0	$0	$0	None
33	42	S	159,516	14	0	14	0	No	3,710	143,564	79,758	$135,961	$48,131	$1,207	Condenser
34	42	S	119,447	65	0	0	0	Yes	4,687	23,531	0	$0	$0	$0	None
35	42	S	53,172	14	0	0	15,021	No	1,638	47,855	26,586	$211,011	$151,296	$11,382	Adsorber
36	42	S	39,974	48	0	0	0	Yes	2,166	7,875	0	$0	$0	$0	None

	Facility #	Portable or Stationary	Uncontrolled HAP Emissions (lb/yr)	Vessel Count	Cover Count	Condenser Count	Carbon Required (lb/mo)	MACT	Flow Rate (scfm)	Baseline HAP Emissions (lb/yr)	MACT Floor HAP Reduction (lb/yr)	MACT Floor TCI ($)	MACT Floor TAC ($/yr)	MACT Floor CE ($/ton)	Control Technology
37	43	P	89,223	106	0	0	0	Yes	2,650	80,301	0	$0	$0	$0	None
38	43	P	61,446	73	0	0	0	Yes	1,825	55,302	0	$0	$0	$0	None
39	43	S	870,908	171	0	171	0	No	12,135	783,817	435,454	$1,457,241	$210,489	$967	Condenser
40	44	P	20,485	13	0	0	0	Yes	395	18,436	0	$0	$0	$0	None
41	44	S	3,414	3	0	3	0	No	75	3,073	1,707	$43,387	$42,069	$49,288	Condenser
42	47	S	325,137	72	0	72	0	No	4,546	292,623	162,568	$624,077	$112,970	$1,390	Condenser
43	50	P	13,731	23	0	0	0	Yes	701	12,358	0	$0	$0	$0	None
44	50	S	41,765	16	0	16	0	No	1,092	37,588	20,882	$152,792	$56,540	$5,415	Condenser
45	51	S	34,423	34	0	34	0	No	1,526	30,980	17,211	$304,277	$79,600	$9,250	Condenser
46	52	P	3,753	70	0	0	0	Yes	2,100	3,378	0	$0	$0	$0	None
47	52	S	7,467	37	0	37	0	No	2,299	6,720	3,733	$329,524	$84,729	$45,390	Condenser
48	52	S	1,896	12	0	0	702	No	684	1,707	948	$48,352	$13,106	$27,645	Adsorber
49	53	P	4,251	100	0	0	0	Yes	2,500	3,826	0	$0	$0	$0	None
50	53	S	680	6	6	6	0	No	270	680	340	$95,461	$50,006	$294,060	Condenser
51	53	S	935	2	0	2	0	No	196	842	468	$34,971	$40,932	$175,055	Condenser
52	53	S	7,567	30	0	0	2,717	No	2,060	6,811	3,784	$119,357	$40,303	$21,304	Adsorber
53	54	S	37,715	19	0	0	10,378	No	915	33,944	18,858	$167,383	$107,672	$11,419	Adsorber
54	56	P	3,024	20	0	0	0	Yes	556	2,722	0	$0	$0	$0	None
55	56	S	5,124	11	0	11	0	No	561	4,612	2,562	$110,713	$52,069	$40,647	Condenser
56	59	S	125,670	126	0	126	0	No	7,016	113,103	62,835	$1,078,530	$191,020	$6,080	Condenser
57	59	S	45,620	8	0	0	0	Yes	1,520	15,967	0	$0	$0	$0	None
58	61	S	184,090	24	0	0	43,527	No	1,146	166,287	91,894	$570,688	$430,731	$9,375	Adsorber
59	64	P	1,665	3	0	0	0	Yes	75	1,499	0	$0	$0	$0	None
60	64	P	555	1	0	0	0	Yes	25	500	0	$0	$0	$0	None
61	64	S	459,735	149	0	149	0	No	9,667	413,762	229,868	$1,272,094	$203,313	$1,769	Condenser
62	65	P	7,098	12	0	0	0	Yes	300	6,388	0	$0	$0	$0	None
63	65	S	77,680	33	0	0	21,182	No	1,735	69,912	38,840	$326,670	$217,458	$11,198	Adsorber
64	66	P	1,828	8	0	0	0	Yes	200	1,645	0	$0	$0	$0	None
65	66	S	228	1	0	1	0	No	25	206	114	$26,555	$39,707	$695,112	Condenser
66	66	S	73,575	62	0	0	22,081	No	3,928	66,217	36,787	$401,452	$236,745	$12,871	Adsorber
67	67	S	67,444	126	0	0	21,691	No	6,756	60,699	33,722	$539,649	$255,609	$15,160	Adsorber
68	68	P	19,518	27	0	0	0	Yes	675	17,566	0	$0	$0	$0	None
69	68	S	723	1	0	1	0	No	25	651	361	$26,555	$39,682	$219,577	Condenser
70	68	S	57,830	10	0	0	15,028	No	834	52,047	28,915	$202,047	$149,658	$10,352	Adsorber
71	69	P	1,345	17	0	0	0	Yes	439	1,210	0	$0	$0	$0	None
72	69	S	16,485	32	0	32	0	No	2,414	14,836	8,242	$287,445	$77,975	$18,920	Condenser
73	69	S	15,240	30	0	0	0	Yes	2,226	762	0	$0	$0	$0	None
74	69	S	1,942	7	0	0	673	No	381	1,748	971	$27,789	$9,658	$19,890	Adsorber

	Facility #	Portable or Stationary	Uncontrolled HAP Emissions (lb/yr)	Vessel Count	Cover Count	Condenser Count	Carbon Required (lb/mo)	MACT	Flow Rate (scfm)	Baseline HAP Emissions (lb/yr)	MACT Floor HAP Reduction (lb/yr)	MACT Floor TCI ($)	MACT Floor TAC ($/yr)	MACT Floor CE ($/ton)	Control Technology
75	70	P	207	1	0	0	0	Yes	39	186	0	$0	$0	$0	None
76	70	S	21,626	52	0	0	7,185	No	2,910	19,464	10,813	$202,963	$88,590	$16,386	Adsorber
77	71	P	23	4	0	0	0	Yes	164	21	0	$0	$0	$0	None
78	71	S	2,156	163	0	0	1,061	No	10,319	1,940	1,078	$670,206	$113,341	$210,304	Adsorber
79	72	P	261	2	0	0	0	Yes	50	235	0	$0	$0	$0	None
80	72	S	3,648	7	0	7	0	No	399	3,283	1,824	$77,050	$47,100	$51,646	Condenser
81	72	S	6,775	20	0	0	2,239	No	868	6,097	3,387	$78,894	$29,931	$17,672	Adsorber
82	73	P	85	5	0	0	0	Yes	125	77	0	$0	$0	$0	None
83	73	S	16,317	161	0	161	0	No	10,997	14,685	8,159	$1,373,083	$240,612	$58,984	Condenser
84	76	P	2,773	65	0	0	0	Yes	1,625	2,496	0	$0	$0	$0	None
85	76	S	25,018	54	0	54	0	No	5,438	22,516	12,509	$472,593	$105,283	$16,833	Condenser
86	76	S	13,483	56	0	0	4,870	No	3,876	12,135	6,742	$223,118	$73,697	$21,863	Adsorber
87	76	S	128	3	0	0	0	Yes	75	6	0	$0	$0	$0	None
88	77	P	4,760	82	0	0	0	Yes	2,050	731	0	$0	$0	$0	None
89	77	S	32,968	84	0	0	0	Yes	6,284	1,648	0	$0	$0	$0	None
90	78	P	18,330	29	0	0	0	Yes	1,075	16,497	0	$0	$0	$0	None
91	78	S	198,460	153	0	153	0	No	7,571	178,614	99,230	$1,305,757	$221,419	$4,463	Condenser
92	78	S	99,117	29	0	0	0	Yes	2,797	4,956	0	$0	$0	$0	None
93	79	P	991	11	0	0	0	Yes	331	892	0	$0	$0	$0	None
94	79	S	2,334	8	0	0	810	No	466	2,101	1,167	$31,693	$11,368	$19,479	Adsorber
95	81	P	73,811	87	0	0	0	Yes	2,483	66,430	0	$0	$0	$0	None
96	81	S	122,793	47	0	47	0	No	2,501	110,514	61,397	$413,682	$91,570	$2,983	Condenser
97	84	P	28,846	5	0	0	0	Yes	125	25,961	0	$0	$0	$0	None
98	84	S	115,383	5	0	5	0	No	285	103,845	57,691	$60,218	$38,992	$1,352	Condenser
99	85	P	14,205	25	25	0	0	No	779	14,205	1,420	$111,780	$16,745	$23,577	Cover
100	85	S	27,883	23	0	23	0	No	1,071	25,095	13,942	$211,703	$66,059	$9,477	Condenser
101	86	P	9,689	15	0	0	0	Yes	375	8,721	0	$0	$0	$0	None
102	86	S	53,185	18	0	18	0	No	1,082	47,866	26,592	$169,624	$58,490	$4,399	Condenser
103	86	S	37,466	10	0	0	9,992	No	684	33,719	18,733	$142,200	$100,740	$10,755	Adsorber
104	88	P	832	59	0	0	0	Yes	1,503	749	0	$0	$0	$0	None
105	88	S	1,710	41	0	41	0	No	1,969	1,539	855	$363,187	$90,060	$210,642	Condenser
106	88	S	14	1	0	0	6	No	25	12	7	$4,112	$675	$197,872	Adsorber
107	90	P	915	2	0	0	0	Yes	50	823	0	$0	$0	$0	None
108	90	S	1,829	3	0	0	543	No	89	1,646	915	$13,389	$6,348	$13,883	Adsorber
109	90	S	9,603	9	0	0	0	Yes	363	1,440	0	$0	$0	$0	None
110	94	P	4,836	5	0	0	0	Yes	385	4,352	0	$0	$0	$0	None
111	94	P	2,611	7	0	0	0	Yes	309	2,350	0	$0	$0	$0	None
112	94	S	2,514	2	0	2	0	No	178	2,263	1,257	$34,971	$40,853	$64,988	Condenser

	Facility #	Portable or Stationary	Uncontrolled HAP Emissions (lb/yr)	Vessel Count	Cover Count	Condenser Count	Carbon Required (lb/mo)	MACT	Flow Rate (scfm)	Baseline HAP Emissions (lb/yr)	MACT Floor HAP Reduction (lb/yr)	MACT Floor TCI ($)	MACT Floor TAC ($/yr)	MACT Floor CE ($/ton)	Control Technology
113	94	S	6,963	12	0	0	2,235	No	684	6,267	3,482	$53,460	$26,008	$14,940	Adsorber
114	98	S	55,044	64	0	64	0	No	3,128	49,540	27,522	$556,751	$116,389	$8,458	Condenser
115	98	S	33,521	11	0	0	9,598	No	1,167	30,169	16,760	$139,411	$97,412	$11,624	Adsorber
116	99	P	401	3	0	0	0	Yes	75	361	0	$0	$0	$0	None
117	99	S	35,461	63	0	63	0	No	3,465	31,915	17,731	$548,335	$116,107	$13,097	Condenser
118	102	P	98,896	146	0	0	0	Yes	5,078	89,007	0	$0	$0	$0	None
119	102	P	9,969	15	0	0	0	Yes	515	100	0	$0	$0	$0	None
120	102	S	123,753	57	0	57	0	No	3,685	111,378	61,877	$497,840	$104,129	$3,366	Condenser
121	102	S	42,802	16	0	0	0	Yes	1,198	428	0	$0	$0	$0	None
122	103	P	1,023	24	0	0	0	Yes	600	921	0	$0	$0	$0	None
123	103	S	12,749	70	0	70	0	No	4,012	11,474	6,375	$607,245	$126,068	$39,553	Condenser
124	106	Stationary	761,781	13	0	13	0	No	2,043	685,603	380,890	$127,545	$16,757	$88	Condenser
125	106	Stationary	5,615	1	0	0	1,347	No	39	5,054	2,808	$18,945	$13,519	$9,630	Adsorber
126	107	Stationary	123	13	0	13	0	No	671	107	57	$127,545	$54,841	$1,932,166	Condenser
127	112	p	3,106	12	0	0	0	Yes	300	2,796	0	$0	$0	$0	None
128	112	S	27,095	15	0	15	0	No	1,119	24,386	13,548	$144,376	$56,013	$8,269	Condenser
129	112	S	2,848	5	0	0	875	No	189	2,563	1,424	$22,992	$10,460	$14,693	Adsorber
130	115	P	3,422	54	0	0	0	Yes	1,546	3,079	0	$0	$0	$0	None
131	115	P	5,183	95	0	0	0	Yes	2,487	4,665	0	$0	$0	$0	None
132	115	S	10,366	68	0	68	0	No	3,246	9,329	5,183	$590,414	$123,666	$47,722	Condenser
133	119	P	1,305	46	0	0	0	Yes	1,206	1,174	0	$0	$0	$0	None
134	119	S	4,314	35	0	35	0	No	2,135	3,883	2,157	$312,692	$82,366	$76,365	Condenser
135	119	S	678	16	0	0	274	No	540	611	339	$65,518	$12,223	$72,063	Adsorber
Total:										6,957,071	3,498,997	$24,403,284	$7,781,013	$4,448	
National Total:										14,725,801	7,406,210	$51,653,618	$16,469,811	$4,448	

ATTACHMENT 3

Estimated Impacts Associated with Process Vessel Control Requirements of the Above-the-floor Regulatory Option

Coating Mfg. Process Vessels (Above Floor)

	Facility #	Uncontrolled HAP Emissions (lb/yr)	Vessel Count	Cover Count	Condenser Count	Carbon Required (lb/mo)	MACT	Flow Rate (scfm)	Baseline HAP Emissions (lb/yr)	Above Floor HAP Reduction (lb/yr)	Above Floor TCI ($)	Above Floor TAC ($/yr)	Above Floor CE ($/ton)	Control Technology
1	1	669,883	7	0	7	0	No	707	602,894	435,424	$81,679	$5,036	$23	Condenser
2	4	1,843	1	0	0	0	No	25	1,659	1,198	$0	$0	$0	None
3	4	88,457	19	0	19	0	No	801	50,126	20,640	$182,669	$61,643	$5,973	Condenser
4	5	12,734	4	0	0	0	Yes	308	2,420	0	$0	$0	$0	None
5	6	37,502	1	1	1	0	No	25	37,502	28,126	$35,655	$38,872	$2,764	Condenser
6	9	10,500	2	0	0	3298	No	78	9,450	6,825	$44,469	$32,813	$9,616	Adsorber
7	10	8,504	44	44	44	0	No	1,478	8,504	6,378	$196,733	$29,471	$9,242	Cover
8	10	958	2	2	2	0	No	114	958	719	$48,542	$43,543	$121,186	Condenser
9	10	4,791	1	0	1	0	No	265	4,312	3,114	$31,184	$40,703	$26,142	Condenser
10	10	4,312	9	0	0	1837	No	513	3,881	2,803	$43,608	$21,309	$15,207	Adsorber
11	13	22,358	8	0	0	8111	No	616	20,122	14,533	$114,329	$81,635	$11,235	Adsorber
12	14	469,515	12	0	0	128968	No	1,032	422,564	305,185	$1,559,619	$1,255,508	$8,228	Adsorber
13	15	305,291	38	0	38	0	No	2,566	274,762	198,439	$342,569	$67,816	$683	Condenser
14	16	5,229	6	0	6	0	No	382	4,706	3,399	$0	$0	$0	None
15	16	3,565	20	0	0	0	No	500	3,209	2,318	$0	$0	$0	None
16	16	8,200	21	0	21	0	No	835	7,380	5,330	$199,500	$65,695	$24,650	Condenser
17	16	3,565	12	0	0	1506	No	392	3,209	2,318	$47,078	$19,153	$16,529	Adsorber
18	17	97,021	12	0	12	0	No	620	87,319	63,063	$123,758	$48,576	$1,541	Condenser
19	21	98,915	13	0	13	0	No	781	89,023	64,295	$132,174	$49,713	$1,546	Condenser
20	29	842	4	0	0	0	No	156	757	547	$0	$0	$0	None
21	29	9,818	6	0	6	0	No	782	8,836	6,382	$73,263	$46,680	$14,630	Condenser
22	29	45,197	33	0	0	18506	No	3,743	40,677	29,378	$295,113	$192,422	$13,100	Adsorber
23	32	15,529	28	28	28	0	No	900	15,529	11,647	$383,604	$92,642	$15,909	Condenser
24	34	44,895	25	0	25	0	No	1,127	40,406	29,182	$233,163	$68,353	$4,685	Condenser
25	34	8,718	2	0	0	0	Yes	154	1,656	0	$0	$0	$0	None
26	39	38,306	80	0	0	0	No	2,000	34,476	24,899	$0	$0	$0	None
27	39	699,568	213	0	213	0	No	15,799	629,611	454,719	$1,815,334	$262,808	$1,156	Condenser
28	40	1,366	8	0	0	0	No	270	1,230	888	$0	$0	$0	None
29	40	23,963	23	0	23	0	No	2,183	21,567	15,576	$216,332	$67,192	$8,628	Condenser
30	41	1,442	10	0	0	0	No	250	1,298	937	$0	$0	$0	None
31	41	59,210	54	0	0	23912	No	4,326	53,289	38,487	$405,140	$251,975	$13,094	Adsorber
32	42	56,970	200	0	0	0	No	5,000	51,273	37,030	$0	$0	$0	None
33	42	159,516	14	0	14	0	No	3,710	143,564	103,685	$140,590	$47,035	$907	Condenser
34	42	119,447	65	0	0	0	Yes	4,687	23,531	0	$0	$0	$0	None
35	42	53,172	14	0	0	19527	No	1,638	47,855	34,562	$264,161	$194,947	$11,281	Adsorber
36	42	39,974	48	0	0	0	Yes	2,166	7,875	0	$0	$0	$0	None

	Facility #	Uncontrolled HAP Emissions (lb/yr)	Vessel Count	Cover Count	Condenser Count	Carbon Required (lb/mo)	MACT	Flow Rate (scfm)	Baseline HAP Emissions (lb/yr)	Above Floor HAP Reduction (lb/yr)	Above Floor TCI ($)	Above Floor TAC ($/yr)	Above Floor CE ($/ton)	Control Technology
37	43	89,223	106	0	106	0	No	2,650	80,301	57,995	$0	$0	$0	None
38	43	61,446	73	0	0	0	No	1,825	55,302	39,940	$0	$0	$0	None
39	43	870,908	171	0	171	0	No	12,135	783,817	566,090	$1,461,870	$198,722	$702	Condenser
40	44	20,485	13	0	0	0	No	395	18,436	13,315	$0	$0	$0	None
41	44	3,414	3	0	3	0	No	75	3,073	2,219	$48,016	$43,314	$39,036	Condenser
42	47	325,137	72	0	72	0	No	4,546	292,623	211,339	$628,706	$109,389	$1,035	Condenser
43	50	13,731	23	0	0	0	No	701	12,358	8,925	$0	$0	$0	None
44	50	41,765	16	0	16	0	No	1,092	37,588	27,147	$157,421	$57,210	$4,215	Condenser
45	51	34,423	34	0	34	0	No	1,526	30,980	22,375	$308,906	$80,380	$7,185	Condenser
46	52	3,753	70	0	0	0	No	2,100	3,378	2,440	$0	$0	$0	None
47	52	7,467	37	0	37	0	No	2,299	6,720	4,853	$334,153	$85,914	$35,404	Condenser
48	52	1,896	12	0	0	913	No	684	1,707	1,233	$48,018	$14,724	$23,891	Adsorber
49	53	4,251	100	0	0	0	No	2,500	3,826	2,763	$0	$0	$0	None
50	53	680	6	6	6	0	No	270	680	510	$100,090	$51,286	$201,058	Condenser
51	53	935	2	0	2	0	No	196	842	608	$39,600	$42,214	$138,875	Condenser
52	53	7,567	30	0	0	3532	No	2,060	6,811	4,919	$118,066	$46,565	$18,933	Adsorber
53	54	37,715	19	0	0	13492	No	915	33,944	24,515	$203,899	$137,801	$11,242	Adsorber
54	56	3,024	20	0	0	0	No	556	2,722	1,966	$0	$0	$0	None
55	56	5,124	11	0	11	0	No	561	4,612	3,331	$115,342	$53,288	$31,999	Condenser
56	59	171,290	134	0	134	0	No	8,536	129,070	81,686	$1,150,486	$200,517	$4,909	Condenser
57	61	184,090	24	0	0	56607	No	1,146	166,287	119,508	$727,066	$557,748	$9,334	Adsorber
58	64	1,665	3	0	3	0	No	75	1,499	1,082	$0	$0	$0	None
59	64	555	1	0	0	0	No	25	500	361	$0	$0	$0	None
60	64	459,735	149	0	149	0	No	9,667	413,762	298,828	$1,276,723	$197,713	$1,323	Condenser
61	65	7,098	12	0	0	0	No	300	6,388	4,613	$0	$0	$0	None
62	65	77,680	33	0	0	27536	No	1,735	69,912	50,492	$401,385	$278,978	$11,050	Adsorber
63	66	1,828	8	0	0	0	No	200	1,645	1,188	$0	$0	$0	None
64	66	228	1	0	1	0	No	25	206	149	$31,184	$41,000	$552,113	Condenser
65	66	73,575	62	0	0	28705	No	3,928	66,217	47,824	$481,392	$301,183	$12,596	Adsorber
66	67	67,444	126	0	0	28199	No	6,756	60,699	43,838	$617,889	$318,868	$14,547	Adsorber
67	68	19,518	27	0	0	0	No	675	17,566	12,687	$0	$0	$0	None
68	68	723	1	0	1	0	No	25	651	470	$31,184	$40,967	$174,375	Condenser
69	68	57,830	10	0	0	19537	No	834	52,047	37,590	$255,194	$193,327	$10,286	Adsorber
70	69	1,345	17	0	0	0	No	439	1,210	874	$0	$0	$0	None
71	69	16,485	32	0	32	0	No	2,414	14,836	10,715	$292,074	$79,024	$14,750	Condenser
72	69	15,240	30	0	0	0	Yes	2,226	762	0	$0	$0	$0	None
73	69	1,942	7	0	0	874	No	381	1,748	1,263	$27,469	$11,208	$17,755	Adsorber
74	70	207	1	0	0	0	No	39	186	134	$0	$0	$0	None

	Facility #	Uncontrolled HAP Emissions (lb/yr)	Vessel Count	Cover Count	Condenser Count	Carbon Required (lb/mo)	MACT	Flow Rate (scfm)	Baseline HAP Emissions (lb/yr)	Above Floor HAP Reduction (lb/yr)	Above Floor TCI ($)	Above Floor TAC ($/yr)	Above Floor CE ($/ton)	Control Technology
75	70	21,626	52	0	0	9341	No	2,910	19,464	14,057	$227,809	$109,383	$15,563	Adsorber
76	71	23	4	0	0	0	No	164	21	15	$0	$0	$0	None
77	71	2,156	163	0	0	1379	No	10,319	1,940	1,401	$669,701	$115,786	$165,262	Adsorber
78	72	261	2	0	0	0	No	50	235	169	$0	$0	$0	None
79	72	3,648	7	0	7	0	No	399	3,283	2,371	$81,679	$48,341	$40,774	Condenser
80	72	6,775	20	0	0	2910	No	868	6,097	4,404	$79,714	$35,373	$16,066	Adsorber
81	73	85	5	0	0	0	No	125	77	55	$0	$0	$0	None
82	73	16,317	161	0	161	0	No	10,997	14,685	10,606	$1,377,712	$241,664	$45,570	Condenser
83	76	2,773	65	0	0	0	No	1,625	2,496	1,803	$0	$0	$0	None
84	76	25,018	54	0	54	0	No	5,438	22,516	16,262	$477,222	$106,205	$13,062	Condenser
85	76	13,483	56	0	0	6331	No	3,876	12,135	8,764	$220,804	$84,921	$19,379	Adsorber
86	76	128	3	0	0	0	Yes	75	6	0	$0	$0	$0	None
87	77	580	10	0	10	0	No	250	522	377	$0	$0	$0	None
88	77	4,179	72	0	0	0	Yes	1,800	209	0	$0	$0	$0	None
89	77	32,968	84	0	0	0	Yes	6,284	1,648	0	$0	$0	$0	None
90	78	18,330	29	0	29	0	No	1,075	16,497	11,914	$0	$0	$0	None
91	78	198,460	153	0	153	0	No	7,571	178,614	128,999	$1,310,386	$219,739	$3,407	Condenser
92	78	99,117	29	0	0	0	Yes	2,797	4,956	0	$0	$0	$0	None
93	79	991	11	0	0	0	No	331	892	644	$0	$0	$0	None
94	79	2,334	8	0	0	1053	No	466	2,101	1,517	$31,308	$13,234	$17,444	Adsorber
95	81	73,811	87	0	0	0	No	2,483	66,430	47,977	$0	$0	$0	None
96	81	122,793	47	0	47	0	No	2,501	110,514	79,816	$418,311	$91,024	$2,281	Condenser
97	84	28,846	5	0	0	0	No	125	25,961	18,750	$0	$0	$0	None
98	84	115,383	5	0	5	0	No	285	103,845	74,999	$64,847	$38,557	$1,028	Condenser
99	85	14,205	25	25	25	0	No	779	14,205	10,654	$111,780	$16,745	$3,144	Cover
100	85	27,883	23	0	23	0	No	1,071	25,095	18,124	$216,332	$66,937	$7,387	Condenser
101	86	9,689	15	0	0	0	No	375	8,721	6,298	$0	$0	$0	None
102	86	53,185	18	0	18	0	No	1,082	47,866	34,570	$174,253	$58,989	$3,413	Condenser
103	86	37,466	10	0	0	12990	No	684	33,719	24,353	$177,016	$129,697	$10,651	Adsorber
104	88	832	59	0	0	0	No	1,503	749	541	$0	$0	$0	None
105	88	1,710	41	0	41	0	No	1,969	1,539	1,112	$367,816	$91,331	$164,319	Condenser
106	88	14	1	0	0	8	No	25	12	9	$4,110	$689	$155,366	Adsorber
107	90	915	2	0	0	0	No	50	823	594	$0	$0	$0	None
108	90	1,829	3	0	0	706	No	89	1,646	1,189	$16,899	$8,165	$13,736	Adsorber
109	90	9,603	9	0	0	0	Yes	363	1,440	0	$0	$0	$0	None
110	94	4,836	5	0	5	0	No	385	4,352	3,143	$0	$0	$0	None
111	94	2,611	7	0	0	0	No	309	2,350	1,697	$0	$0	$0	None
112	94	2,514	2	0	2	0	No	178	2,263	1,634	$39,600	$42,112	$51,532	Condenser

	Facility #	Uncontrolled HAP Emissions (lb/yr)	Vessel Count	Cover Count	Condenser Count	Carbon Required (lb/mo)	MACT	Flow Rate (scfm)	Baseline HAP Emissions (lb/yr)	Above Floor HAP Reduction (lb/yr)	Above Floor TCI ($)	Above Floor TAC ($/yr)	Above Floor CE ($/ton)	Control Technology
113	94	6,963	12	0	0	2905	No	684	6,267	4,526	$61,818	$32,570	$14,392	Adsorber
114	98	55,044	64	0	64	0	No	3,128	49,540	35,779	$561,380	$116,860	$6,532	Condenser
115	98	33,521	11	0	0	12477	No	1,167	30,169	21,788	$174,414	$125,459	$11,516	Adsorber
116	99	401	3	0	0	0	No	75	361	261	$0	$0	$0	None
117	99	35,461	63	0	63	0	No	3,465	31,915	23,050	$552,964	$116,872	$10,141	Condenser
118	102	98,896	146	0	146	0	No	5,078	89,007	64,283	$0	$0	$0	None
119	102	9,969	15	0	0	0	Yes	515	100	0	$0	$0	$0	None
120	102	123,753	57	0	57	0	No	3,685	111,378	80,440	$502,469	$103,569	$2,575	Condenser
121	102	42,802	16	0	0	0	Yes	1,198	428	0	$0	$0	$0	None
122	103	1,023	24	0	0	0	No	600	921	665	$0	$0	$0	None
123	103	12,749	70	0	70	0	No	4,012	11,474	8,287	$611,874	$127,173	$30,692	Condenser
124	106	761,781	13	0	13	0	No	2,043	685,603	495,158	$132,174	$6,627	$27	Condenser
125	106	5,615	1	0	0	1750	No	39	5,054	3,650	$23,957	$17,470	$9,573	Adsorber
126	107	123	13	0	13	0	No	671	107	75	$132,174	$56,135	$1,494,118	Condenser
127	112	3,106	12	0	0	0	No	300	2,796	2,019	$0	$0	$0	None
128	112	27,095	15	0	15	0	No	1,119	24,386	17,612	$149,005	$56,903	$6,462	Condenser
129	112	2,848	5	0	0	1138	No	189	2,563	1,851	$26,344	$13,042	$14,092	Adsorber
130	115	3,422	54	0	54	0	No	1,546	3,079	2,224	$0	$0	$0	None
131	115	5,183	95	0	0	0	No	2,487	4,665	3,369	$0	$0	$0	None
132	115	10,366	68	0	68	0	No	3,246	9,329	6,738	$595,043	$124,807	$37,048	Condenser
133	119	1,305	46	0	0	0	No	1,206	1,174	848	$0	$0	$0	None
134	119	4,314	35	0	35	0	No	2,135	3,883	2,804	$317,321	$83,597	$59,620	Condenser
135	119	678	16	0	0	356	No	540	611	441	$65,388	$12,855	$58,299	Adsorber
Total:									6,957,071	4,966,494	$25,840,023	$8,739,711	$3,519	
National Total:									14,725,801	10,512,412	$54,694,715	$18,499,055	$3,519	

ATTACHMENT 4

**Estimated Impacts Associated with
Vertical Storage Tank Control Requirements of the
Above Floor Regulatory Option 1**

Coating Mfg. Vertical Storage Tanks => 10,000 gal and => 3.0 psia (Option 1)

	Facility #	Tank ID	Tank Capacity (gal)	Estimated HAP Partial Pressure (psia)	Uncontrolled HAP Emissions (lb/yr)	Control Device	Control Efficiency	Baseline HAP Emissions (lb/yr)	HAP Reduction (lb/yr)	TAC ($/ton)	TCI ($)	CE ($/ton)
1	34	# 8	20,000	6.73	3,859			3,859	3,087	$2,457	$11,317	$1,592
2	51	15	11,000	6.73	3,859			3,859	3,087	$2,059	$9,720	$1,334
3	124	9	20,000	3.34	1,915		0.00	1,915	1,532	$2,642	$11,317	$3,448
								84,780	7,706	$7,158	$32,354	$1,858

ATTACHMENT 5

Estimated Impacts Associated with Vertical Storage Tank Control Requirements of the Above Floor Regulatory Option 2

Coating Mfg. Vertical Storage Tanks => 10,000 gal and => 1.9 psia (Option 2)

	Facility #	Tank ID	Tank Capacity (gal)	Estimated HAP Partial Pressure (psia)	Uncontrolled HAP Emissions (lb/yr)	Control Device	Control Efficiency	Baseline HAP Emissions (lb/yr)	HAP Reduction (lb/yr)	TAC ($/ton)	TCI ($)	CE ($/ton)
1	4	T001	12,000	2.02	1,161			1,161	929	$2,328	$9,769	$5,013
2	25	#22	15,000	1.90	1,090			1,090	872	$2,520	$10,511	$5,782
3	32	T002	15,000	2.33	1,334			1,334	1,067	$2,497	$10,511	$4,679
4	34	# 13	20,000	2.33	1,334			1,334	1,067	$2,698	$11,317	$5,056
5	34	# 14	20,000	2.33	1,334			1,334	1,067	$2,698	$11,317	$5,056
6	34	# 7	20,000	2.02	1,161			1,161	929	$2,714	$11,317	$5,844
7	34	# 8	20,000	6.73	3,859			3,859	3,087	$2,457	$11,317	$1,592
8	51	15	11,000	6.73	3,859			3,859	3,087	$2,059	$9,720	$1,334
9	107	101	11,000	2.35	1,348			1,348	1,078	$2,298	$9,720	$4,263
10	124	9	20,000	3.34	1,915		0.00	1,915	1,532	$2,642	$11,317	$3,448
								84,780	14,716	$24,911	$106,816	$3,386

ATTACHMENT 6

Estimated Impacts Associated with
Horizontal Storage Tank Control Requirements of the
Above Floor Regulatory Option 1

Coating Mfg. Horizontal Tanks => 250 gal and => 3.0 psia (Option 1)

	Facility #	Tank ID	Tank Capacity (gal)	Estimated HAP Partial Pressure (psia)	Uncontrolled HAP Emissions (lb/yr)	Control Device	Control Efficiency	Baseline HAP Emissions (lb/yr)	HAP Reduction (lb/yr)	TAC ($/yr)	TCI ($)	CE ($/ton)
1	72	Tank #21	12,000	6.73	8,209			8,209	7,798	$16,500	$23,500	$4,232
								63,180	7,798	$16,500	$23,500	$4,232

ATTACHMENT 7

Estimated Impacts Associated with Horizontal Storage Tank Control Requirements of the Above Floor Regulatory Option 2

Coating Mfg. Horizontal Tanks => 250 gal and => 1.9 psia (Option 2)

	Facility #	Tank ID	Tank Capacity (gal)	Estimated HAP Partial Pressure (psia)	Uncontrolled HAP Emissions (lb/yr)	Control Device	Control Efficiency	Baseline HAP Emissions (lb/yr)	HAP Reduction (lb/yr)	TAC ($/yr)	TCI ($)	CE ($/ton)
1	4	T033	12,000	2.33	2,838			2,838	2,696	$16,500	$23,500	$12,240
2	72	Tank #21	12,000	6.73	8,209			8,209	7,798	$16,500	$23,500	$4,232
3	77	T-6100-1	12,500	2.60	3,172			3,172	3,013	$16,500	$23,500	$10,952
4	112	HS-3147	15,000	2.02	2,470		0.00	2,470	2,346	$16,500	$23,500	$14,064
								63,180	15,854	$66,000	$94,000	$8,326

ATTACHMENT 8

Estimated Impacts Associated with LDAR Control Requirements of the MACT Floor Regulatory Option

Coating Mfg. LDAR Program (MACT Floor)

	Facility #	*Total Vessels at Plant*	*LDAR Program*	*Uncontrolled HAP (tons/yr)*	*MACT SOCMI*	*Baseline HAP (tons/yr)*	*MACT Floor HAP Reduction (tons/yr)*	*MACT Floor TCI ($)*	*MACT Floor TAC ($/yr)*	*MACT Floor CE ($/ton)*
1	21	13	Yes	2.10	No	2.10	0.60	$3,505	$1,299	$2,154
2	110	47	YES	7.58	Yes	5.40	0.00	$0	$0	$0
3	118	82	YES	13.22	Yes	9.41	0.00	$0	$0	$0
4	106	14	Yes	2.26	Yes	1.61	0.00	$0	$0	$0
5	29	43	Yes	6.93	Yes	4.94	0.00	$0	$0	$0
6	9	2	Yes	0.32	Yes	0.23	0.00	$0	$0	$0
7	7	3	Yes	0.48	Yes	0.34	0.00	$0	$0	$0
8	1	7	YES	1.13	No	1.13	0.32	$3,260	$917	$2,822
9	16	59	Yes	9.51	Yes	6.77	0.00	$0	$0	$0
10	109	52	YES	8.38	No	8.38	2.41	$5,100	$3,787	$1,569
11	26	5	Yes	0.81	No	0.81	0.23	$3,178	$789	$3,402
12	61	24	Yes	3.87	Yes	2.76	0.00	$0	$0	$0
13	34	27	Yes	4.35	Yes	3.10	0.00	$0	$0	$0
14	113	118	YES	19.02	Yes	13.55	0.00	$0	$0	$0
15	49	65	Yes	10.48	Yes	7.46	0.00	$0	$0	$0
16	22	11	Yes	1.77	Yes	1.26	0.00	$0	$0	$0
17	101	17	Yes	2.74	Yes	1.95	0.00	$0	$0	$0
18	71	167	Yes	26.92	Yes	19.17	0.00	$0	$0	$0
19	73	166	Yes	26.76	No	26.76	7.70	$9,760	$11,057	$1,436
20	69	86	Yes	13.86	Yes	9.87	0.00	$0	$0	$0
21	72	29	Yes	4.67	Yes	3.33	0.00	$0	$0	$0
22	37	64	Yes	10.32	Yes	7.35	0.00	$0	$0	$0
23	114	41	YES	6.61	No	6.61	1.90	$4,650	$3,085	$1,622
24	43	350	Yes	56.42	Yes	40.18	0.00	$0	$0	$0
25	86	43	Yes	6.93	Yes	4.94	0.00	$0	$0	$0
26	53	138	Yes	22.25	Yes	15.84	0.00	$0	$0	$0
27	30	9	Yes	1.45	Yes	1.03	0.00	$0	$0	$0
28	50	39	Yes	6.29	Yes	4.48	0.00	$0	$0	$0
29	27	3	Yes	0.48	Yes	0.34	0.00	$0	$0	$0
30	57	24	Yes	3.87	Yes	2.76	0.00	$0	$0	$0
31	58	17	Yes	2.74	Yes	1.95	0.00	$0	$0	$0
32	33	2	Yes	0.32	Yes	0.23	0.00	$0	$0	$0
33	82	44	Yes	7.09	Yes	5.05	0.00	$0	$0	$0
34	44	16	YES	2.58	Yes	1.84	0.00	$0	$0	$0
35	51	34	Yes	5.48	Yes	3.90	0.00	$0	$0	$0
36	19	6	Yes	0.97	Yes	0.69	0.00	$0	$0	$0
37	25	39	Yes	6.29	Yes	4.48	0.00	$0	$0	$0
38	104	6	Yes	0.97	Yes	0.69	0.00	$0	$0	$0
39	103	94	Yes	15.15	Yes	10.79	0.00	$0	$0	$0
40	18	17	Yes	2.74	Yes	1.95	0.00	$0	$0	$0
41	105	100	Yes	16.12	Yes	11.48	0.00	$0	$0	$0
42	20	30	Yes	4.84	Yes	3.44	0.00	$0	$0	$0
43	14	12	Yes	1.93	Yes	1.38	0.00	$0	$0	$0
44	13	8	Yes	1.29	Yes	0.92	0.00	$0	$0	$0
45	12	5	Yes	0.81	Yes	0.57	0.00	$0	$0	$0

	Facility #	Total Vessels at Plant	LDAR Program	Uncontrolled HAP (tons/yr)	MACT SOCMI	Baseline HAP (tons/yr)	MACT Floor HAP Reduction (tons/yr)	MACT Floor TCI ($)	MACT Floor TAC ($/yr)	MACT Floor CE ($/ton)
46	76	178	Yes	28.69	Yes	20.43	0.00	$0	$0	$0
47	15	38	Yes	6.13	No	6.13	1.76	$4,527	$2,894	$1,641
48	87	5	Yes	0.81	No	0.81	0.23	$3,178	$789	$3,402
49	28	7	Yes	1.13	No	1.13	0.32	$3,260	$917	$2,822
50	10	56		9.03	No	9.03	2.60	$5,263	$4,042	$1,556
51	47	72		11.61	No	11.61	3.34	$5,917	$5,062	$1,515
52	48	155		24.99	No	24.99	7.19	$9,310	$10,356	$1,440
53	46	113		18.22	No	18.22	5.24	$7,593	$7,677	$1,464
54	6	1		0.16	No	0.16	0.05	$3,015	$534	$11,510
55	41	64		10.32	No	10.32	2.97	$5,590	$4,552	$1,533
56	5	4		0.64	No	0.64	0.19	$3,138	$725	$3,908
57	4	20		3.22	No	3.22	0.93	$3,792	$1,746	$1,881
58	3	3		0.48	No	0.48	0.14	$3,097	$662	$4,753
59	2	31		5.00	No	5.00	1.44	$4,241	$2,447	$1,701
60	52	119		19.18	No	19.18	5.52	$7,839	$8,060	$1,460
61	8	96		15.48	No	15.48	4.45	$6,898	$6,593	$1,480
62	45	27		4.35	No	4.35	1.25	$4,078	$2,192	$1,750
63	11	24		3.87	No	3.87	1.11	$3,955	$2,001	$1,797
64	42	341		54.97	No	54.97	15.82	$16,914	$22,219	$1,404
65	40	31		5.00	No	5.00	1.44	$4,241	$2,447	$1,701
66	39	293		47.23	No	47.23	13.60	$14,952	$19,157	$1,409
67	36	4		0.64	No	0.64	0.19	$3,138	$725	$3,908
68	35	3		0.48	No	0.48	0.14	$3,097	$662	$4,753
69	32	28		4.51	No	4.51	1.30	$4,119	$2,256	$1,737
70	31	81		13.06	No	13.06	3.76	$6,285	$5,636	$1,500
71	23	83		13.38	No	13.38	3.85	$6,367	$5,764	$1,497
72	24	30		4.84	No	4.84	1.39	$4,200	$2,384	$1,712
73	66	71		11.45	No	11.45	3.29	$5,876	$4,999	$1,517
74	17	12		1.93	No	1.93	0.56	$3,465	$1,236	$2,219
75	115	217		34.98	No	34.98	10.07	$11,845	$14,310	$1,421
76	94	26		4.19	No	4.19	1.21	$4,037	$2,129	$1,764
77	95	116		18.70	No	18.70	5.38	$7,716	$7,869	$1,462
78	96	56		9.03	No	9.03	2.60	$5,263	$4,042	$1,556
79	97	22		3.55	No	3.55	1.02	$3,873	$1,873	$1,835
80	98	75		12.09	No	12.09	3.48	$6,040	$5,254	$1,510
81	99	66		10.64	No	10.64	3.06	$5,672	$4,680	$1,528
82	100	35		5.64	No	5.64	1.62	$4,405	$2,703	$1,664
83	102	234		37.72	No	37.72	10.86	$12,540	$15,394	$1,418
84	107	13		2.10	No	2.10	0.60	$3,505	$1,299	$2,154
85	108	40		6.45	No	6.45	1.86	$4,609	$3,021	$1,628
86	64	153		24.66	No	24.66	7.10	$9,229	$10,228	$1,441
87	112	32		5.16	No	5.16	1.48	$4,282	$2,511	$1,691
88	91	61		9.83	No	9.83	2.83	$5,468	$4,361	$1,541
89	116	126		20.31	No	20.31	5.85	$8,125	$8,506	$1,455
90	117	8		1.29	No	1.29	0.37	$3,301	$981	$2,641
91	119	97		15.64	No	15.64	4.50	$6,939	$6,657	$1,479
92	120	71		11.45	No	11.45	3.29	$5,876	$4,999	$1,517
93	121	93		14.99	No	14.99	4.32	$6,776	$6,402	$1,484

	Facility #	Total Vessels at Plant	LDAR Program	Uncontrolled HAP (tons/yr)	MACT SOCMI	Baseline HAP (tons/yr)	MACT Floor HAP Reduction (tons/yr)	MACT Floor TCI ($)	MACT Floor TAC ($/yr)	MACT Floor CE ($/ton)
94	122	37		5.96	No	5.96	1.72	$4,487	$2,830	$1,648
95	123	48		7.74	No	7.74	2.23	$4,936	$3,532	$1,586
96	124	147		23.70	No	23.70	6.82	$8,983	$9,846	$1,443
97	125	30		4.84	No	4.84	1.39	$4,200	$2,384	$1,712
98	126	79		12.73	No	12.73	3.67	$6,204	$5,509	$1,503
99	127	66		10.64	No	10.64	3.06	$5,672	$4,680	$1,528
100	111	6		0.97	No	0.97	0.28	$3,219	$853	$3,064
101	77	166		26.76	No	26.76	7.70	$9,760	$11,057	$1,436
102	55	12		1.93	No	1.93	0.56	$3,465	$1,236	$2,219
103	56	31		5.00	No	5.00	1.44	$4,241	$2,447	$1,701
104	59	134		21.60	No	21.60	6.22	$8,452	$9,017	$1,450
105	60	8		1.29	No	1.29	0.37	$3,301	$981	$2,641
106	62	14		2.26	No	2.26	0.65	$3,546	$1,363	$2,099
107	63	35		5.64	No	5.64	1.62	$4,405	$2,703	$1,664
108	65	45		7.25	No	7.25	2.09	$4,814	$3,340	$1,600
109	128	68		10.96	No	10.96	3.16	$5,754	$4,807	$1,524
110	67	126		20.31	No	20.31	5.85	$8,125	$8,506	$1,455
111	68	38		6.13	No	6.13	1.76	$4,527	$2,894	$1,641
112	70	53		8.54	No	8.54	2.46	$5,141	$3,851	$1,566
113	93	50		8.06	No	8.06	2.32	$5,018	$3,659	$1,577
114	75	51		8.22	No	8.22	2.37	$5,059	$3,723	$1,573
115	92	4		0.64	No	0.64	0.19	$3,138	$725	$3,908
116	78	211		34.01	No	34.01	9.79	$11,600	$13,927	$1,423
117	79	19		3.06	No	3.06	0.88	$3,751	$1,682	$1,908
118	80	55		8.87	No	8.87	2.55	$5,222	$3,978	$1,559
119	81	134		21.60	No	21.60	6.22	$8,452	$9,017	$1,450
120	83	6		0.97	No	0.97	0.28	$3,219	$853	$3,064
121	84	10		1.61	No	1.61	0.46	$3,383	$1,108	$2,388
122	85	48		7.74	No	7.74	2.23	$4,936	$3,532	$1,586
123	88	101		16.28	No	16.28	4.69	$7,103	$6,912	$1,475
124	89	40		6.45	No	6.45	1.86	$4,609	$3,021	$1,628
125	90	14		2.26	No	2.26	0.65	$3,546	$1,363	$2,099
126	54	19		3.06	No	3.06	0.88	$3,751	$1,682	$1,908
127	74	25		4.03	No	4.03	1.16	$3,996	$2,065	$1,780
						1,135	258	$486,317	$395,968	$1,533

ATTACHMENT 9

Estimated Impacts Associated with LDAR Control Requirements of the Above-the-floor Regulatory Option

Coating Mfg. LDAR Program (Above Floor)

	Facility #	Total Vessels at Plant	LDAR Program	Uncontrolled HAP (tons/yr)	MACT SOCMI	Baseline HAP (tons/yr)	Above Floor HAP Reduction (tons/yr)	Above Floor TCI ($)	Above Floor TAC ($/yr)	Above Floor CE ($/ton)
1	21	13	Yes	2.10	No	2.10	1.28	$5,426	$7,022	$5,467
2	110	47	YES	7.58	Yes	5.40	2.46	$1,921	$7,235	$2,938
3	118	82	YES	13.22	Yes	9.41	4.30	$1,921	$8,791	$2,046
4	106	14	Yes	2.26	Yes	1.61	0.73	$1,921	$5,767	$7,861
5	29	43	Yes	6.93	Yes	4.94	2.25	$1,921	$7,057	$3,132
6	9	2	Yes	0.32	Yes	0.23	0.10	$1,921	$5,233	$49,936
7	7	3	Yes	0.48	Yes	0.34	0.16	$1,921	$5,278	$33,574
8	1	7	YES	1.13	No	1.13	0.69	$5,181	$6,372	$9,214
9	16	59	Yes	9.51	Yes	6.77	3.09	$1,921	$7,768	$2,513
10	109	52	YES	8.38	No	8.38	5.14	$7,021	$11,244	$2,189
11	26	5	Yes	0.81	No	0.81	0.49	$5,099	$6,156	$12,461
12	61	24	Yes	3.87	Yes	2.76	1.26	$1,921	$6,212	$4,939
13	34	27	Yes	4.35	Yes	3.10	1.41	$1,921	$6,345	$4,485
14	113	118	YES	19.02	Yes	13.55	6.18	$1,921	$10,392	$1,681
15	49	65	Yes	10.48	Yes	7.46	3.41	$1,921	$8,035	$2,359
16	22	11	Yes	1.77	Yes	1.26	0.58	$1,921	$5,634	$9,774
17	101	17	Yes	2.74	Yes	1.95	0.89	$1,921	$5,900	$6,624
18	71	167	Yes	26.92	Yes	19.17	8.75	$1,921	$12,571	$1,437
19	73	166	Yes	26.76	No	26.76	16.40	$11,681	$23,584	$1,438
20	69	86	Yes	13.86	Yes	9.87	4.51	$1,921	$8,969	$1,990
21	72	29	Yes	4.67	Yes	3.33	1.52	$1,921	$6,434	$4,234
22	37	64	Yes	10.32	Yes	7.35	3.35	$1,921	$7,991	$2,383
23	114	41	YES	6.61	No	6.61	4.05	$6,571	$10,053	$2,482
24	43	350	Yes	56.42	Yes	40.18	18.34	$1,921	$20,710	$1,129
25	86	43	Yes	6.93	Yes	4.94	2.25	$1,921	$7,057	$3,132
26	53	138	Yes	22.25	Yes	15.84	7.23	$1,921	$11,282	$1,560
27	30	9	Yes	1.45	Yes	1.03	0.47	$1,921	$5,545	$11,757
28	50	39	Yes	6.29	Yes	4.48	2.04	$1,921	$6,879	$3,366
29	27	3	Yes	0.48	Yes	0.34	0.16	$1,921	$5,278	$33,574
30	57	24	Yes	3.87	Yes	2.76	1.26	$1,921	$6,212	$4,939
31	58	17	Yes	2.74	Yes	1.95	0.89	$1,921	$5,900	$6,624
32	33	2	Yes	0.32	Yes	0.23	0.10	$1,921	$5,233	$49,936
33	82	44	Yes	7.09	Yes	5.05	2.31	$1,921	$7,101	$3,080
34	44	16	YES	2.58	Yes	1.84	0.84	$1,921	$5,856	$6,985
35	51	34	Yes	5.48	Yes	3.90	1.78	$1,921	$6,656	$3,736
36	19	6	Yes	0.97	Yes	0.69	0.31	$1,921	$5,411	$17,211
37	25	39	Yes	6.29	Yes	4.48	2.04	$1,921	$6,879	$3,366
38	104	6	Yes	0.97	Yes	0.69	0.31	$1,921	$5,411	$17,211
39	103	94	Yes	15.15	Yes	10.79	4.93	$1,921	$9,325	$1,893
40	18	17	Yes	2.74	Yes	1.95	0.89	$1,921	$5,900	$6,624
41	105	100	Yes	16.12	Yes	11.48	5.24	$1,921	$9,592	$1,830
42	20	30	Yes	4.84	Yes	3.44	1.57	$1,921	$6,479	$4,121
43	14	12	Yes	1.93	Yes	1.38	0.63	$1,921	$5,678	$9,030

	Facility #	Total Vessels at Plant	LDAR Program	Uncontrolled HAP (tons/yr)	MACT SOCMI	Baseline HAP (tons/yr)	Above Floor HAP Reduction (tons/yr)	Above Floor TCI ($)	Above Floor TAC ($/yr)	Above Floor CE ($/ton)
44	13	8	Yes	1.29	Yes	0.92	0.42	$1,921	$5,500	$13,121
45	12	5	Yes	0.81	Yes	0.57	0.26	$1,921	$5,367	$20,484
46	76	178	Yes	28.69	Yes	20.43	9.33	$1,921	$13,060	$1,400
47	15	38	Yes	6.13	No	6.13	3.75	$6,448	$9,728	$2,591
48	87	5	Yes	0.81	No	0.81	0.49	$5,099	$6,156	$12,461
49	28	7	Yes	1.13	No	1.13	0.69	$5,181	$6,372	$9,214
50	10	56		9.03	No	9.03	5.53	$7,184	$11,677	$2,110
51	47	72		11.61	No	11.61	7.11	$7,838	$13,409	$1,885
52	48	155		24.99	No	24.99	15.31	$11,231	$22,393	$1,462
53	46	113		18.22	No	18.22	11.16	$9,514	$17,847	$1,599
54	6	1		0.16	No	0.16	0.10	$4,936	$5,723	$57,925
55	41	64		10.32	No	10.32	6.32	$7,511	$12,543	$1,984
56	5	4		0.64	No	0.64	0.40	$5,059	$6,048	$15,303
57	4	20		3.22	No	3.22	1.98	$5,713	$7,780	$3,937
58	3	3		0.48	No	0.48	0.30	$5,018	$5,939	$20,039
59	2	31		5.00	No	5.00	3.06	$6,162	$8,970	$2,929
60	52	119		19.18	No	19.18	11.76	$9,760	$18,496	$1,573
61	8	96		15.48	No	15.48	9.48	$8,819	$16,007	$1,688
62	45	27		4.35	No	4.35	2.67	$5,999	$8,537	$3,200
63	11	24		3.87	No	3.87	2.37	$5,876	$8,213	$3,464
64	42	341		54.97	No	54.97	33.69	$18,835	$42,528	$1,262
65	40	31		5.00	No	5.00	3.06	$6,162	$8,970	$2,929
66	39	293		47.23	No	47.23	28.95	$16,873	$37,332	$1,290
67	36	4		0.64	No	0.64	0.40	$5,059	$6,048	$15,303
68	35	3		0.48	No	0.48	0.30	$5,018	$5,939	$20,039
69	32	28		4.51	No	4.51	2.77	$6,040	$8,646	$3,125
70	31	81		13.06	No	13.06	8.00	$8,206	$14,383	$1,797
71	23	83		13.38	No	13.38	8.20	$8,288	$14,599	$1,780
72	24	30		4.84	No	4.84	2.96	$6,121	$8,862	$2,990
73	66	71		11.45	No	11.45	7.01	$7,797	$13,300	$1,896
74	17	12		1.93	No	1.93	1.19	$5,386	$6,914	$5,831
75	115	217		34.98	No	34.98	21.44	$13,766	$29,105	$1,358
76	94	26		4.19	No	4.19	2.57	$5,958	$8,429	$3,281
77	95	116		18.70	No	18.70	11.46	$9,637	$18,172	$1,586
78	96	56		9.03	No	9.03	5.53	$7,184	$11,677	$2,110
79	97	22		3.55	No	3.55	2.17	$5,794	$7,996	$3,679
80	98	75		12.09	No	12.09	7.41	$7,961	$13,733	$1,853
81	99	66		10.64	No	10.64	6.52	$7,593	$12,759	$1,957
82	100	35		5.64	No	5.64	3.46	$6,326	$9,403	$2,719
83	102	234		37.72	No	37.72	23.12	$14,461	$30,945	$1,339
84	107	13		2.10	No	2.10	1.28	$5,426	$7,022	$5,467
85	108	40		6.45	No	6.45	3.95	$6,530	$9,945	$2,516
86	64	153		24.66	No	24.66	15.12	$11,150	$22,177	$1,467
87	112	32		5.16	No	5.16	3.16	$6,203	$9,079	$2,872
88	91	61		9.83	No	9.83	6.03	$7,389	$12,218	$2,027

	Facility #	Total Vessels at Plant	LDAR Program	Uncontrolled HAP (tons/yr)	MACT SOCMI	Baseline HAP (tons/yr)	Above Floor HAP Reduction (tons/yr)	Above Floor TCI ($)	Above Floor TAC ($/yr)	Above Floor CE ($/ton)
89	116	126		20.31	No	20.31	12.45	$10,046	$19,254	$1,547
90	117	8		1.29	No	1.29	0.79	$5,222	$6,481	$8,199
91	119	97		15.64	No	15.64	9.58	$8,860	$16,115	$1,682
92	120	71		11.45	No	11.45	7.01	$7,797	$13,300	$1,896
93	121	93		14.99	No	14.99	9.19	$8,697	$15,682	$1,707
94	122	37		5.96	No	5.96	3.66	$6,408	$9,620	$2,632
95	123	48		7.74	No	7.74	4.74	$6,857	$10,811	$2,280
96	124	147		23.70	No	23.70	14.52	$10,904	$21,527	$1,482
97	125	30		4.84	No	4.84	2.96	$6,121	$8,862	$2,990
98	126	79		12.73	No	12.73	7.81	$8,125	$14,166	$1,815
99	127	66		10.64	No	10.64	6.52	$7,593	$12,759	$1,957
100	111	6		0.97	No	0.97	0.59	$5,140	$6,264	$10,567
101	77	166		26.76	No	26.76	16.40	$11,681	$23,584	$1,438
102	55	12		1.93	No	1.93	1.19	$5,386	$6,914	$5,831
103	56	31		5.00	No	5.00	3.06	$6,162	$8,970	$2,929
104	59	134		21.60	No	21.60	13.24	$10,373	$20,120	$1,520
105	60	8		1.29	No	1.29	0.79	$5,222	$6,481	$8,199
106	62	14		2.26	No	2.26	1.38	$5,467	$7,130	$5,155
107	63	35		5.64	No	5.64	3.46	$6,326	$9,403	$2,719
108	65	45		7.25	No	7.25	4.45	$6,735	$10,486	$2,359
109	128	68		10.96	No	10.96	6.72	$7,675	$12,976	$1,931
110	67	126		20.31	No	20.31	12.45	$10,046	$19,254	$1,547
111	68	38		6.13	No	6.13	3.75	$6,448	$9,728	$2,591
112	70	53		8.54	No	8.54	5.24	$7,062	$11,352	$2,168
113	93	50		8.06	No	8.06	4.94	$6,939	$11,027	$2,232
114	75	51		8.22	No	8.22	5.04	$6,980	$11,135	$2,210
115	92	4		0.64	No	0.64	0.40	$5,059	$6,048	$15,303
116	78	211		34.01	No	34.01	20.85	$13,521	$28,455	$1,365
117	79	19		3.06	No	3.06	1.88	$5,672	$7,671	$4,087
118	80	55		8.87	No	8.87	5.43	$7,143	$11,568	$2,129
119	81	134		21.60	No	21.60	13.24	$10,373	$20,120	$1,520
120	83	6		0.97	No	0.97	0.59	$5,140	$6,264	$10,567
121	84	10		1.61	No	1.61	0.99	$5,304	$6,697	$6,779
122	85	48		7.74	No	7.74	4.74	$6,857	$10,811	$2,280
123	88	101		16.28	No	16.28	9.98	$9,024	$16,548	$1,658
124	89	40		6.45	No	6.45	3.95	$6,530	$9,945	$2,516
125	90	14		2.26	No	2.26	1.38	$5,467	$7,130	$5,155
126	54	19		3.06	No	3.06	1.88	$5,672	$7,671	$4,087
127	74	25		4.03	No	4.03	2.47	$5,917	$8,321	$3,369
						1,135	659	$730,284	$1,389,029	$2,109

ATTACHMENT 10

Estimated Impacts Associated with Wastewater Control Requirements of the MACT Floor Regulatory Option

Coating Mfg. Wastewater with Flow Rate => 22,000 gal/yr and Concentration => 4,000 ppm (MACT Floor)

	Facility #	Waste Water ID	Flow Rate (l/min)	HAP Concentration (ppm)	Uncontrolled HAP Emissions (tpy)	Treatment Code	MACT	Baseline HAP (tpy)	HAP Reduction (tpy)	TCI ($)	TAC ($/yr)	CE ($/ton)
1	41	EPXCWLL201	0.49	210,000	8.37	TT	0	7.95	7.79	$435,727	$150,497	$19,320
2	65	WW1	0.63	4,000	0.21	*OF-Combustion, RCRA wa	-1	0.20	0.00	$0	$0	$0
3	67	WW1	3.60	10,000	0.83	OF-Landfill solidification	0	0.79	0.14	$439,885	$153,026	$1,078,179
4	124	Latex	3.60	10,000	0.83	TT/DP	0	0.79	0.14	$439,885	$153,026	$1,078,179
Total:								10.88	8.07	$1,315,497	$456,549	$56,549

Wastewater Treatment Codes:

HT=Holding tank	OP=Open pond	AS=Air stripper
BI=Biological treatment	EQ=Equalization pond	DP=Discharge to a POTW
CL=Clarifier	TT=Treatment tank	O=Other
SS=Steam stripper	OF=Offsite destruction	

ATTACHMENT 11

Estimated Impacts Associated with Wastewater Control Requirements of the Above-the-floor Regulatory Option

Coating Mfg. Wastewater with Flow Rate => 880 gal/yr and Concentration => 1,000 ppm (Above Floor)

	Facility #	Waste Water ID	Flow Rate (l/min)	HAP Concentration (ppm)	Uncontrolled HAP Emissions (tpy)	Treatment Code	MACT	Baseline HAP (tpy)	HAP Reduction (tpy)	TCI ($)	TAC ($/yr)	CE ($/ton)
1	41	EPXCWLL201	0.49	210,000	8.37	TT	0	7.95	7.79	$435,727	$150,497	$19,320
2	43	Tank 1909	2.57	3,000	0.18	TT, DP	0	0.17	0.03	$438,510	$152,190	$5,006,018
3	65	WW1	0.63	4,000	0.21	*OF-Combustion, RCRA was	-1	0.20	0.00	$0	$0	$0
4	67	WW1	3.60	10,000	0.83	OF-Landfill solidification	0	0.79	0.14	$439,885	$153,026	$1,078,179
5	94	WW01	0.05	40,000	0.05	*OF-Combustion, RCRA was	-1	0.04	0.00	$0	$0	$0
6	94	WW02	0.01	1,600	0.00	*OF-Combustion, RCRA was	-1	0.00	0.00	$0	$0	$0
7	101	LF	0.03	100,000	0.86	*OF-Combustion, RCRA was	-1	0.81	0.00	$0	$0	$0
8	119	WBP	0.27	2,000	0.04	*OF-Combustion, RCRA was	-1	0.04	0.00	$0	$0	$0
9	124	Latex	3.60	10,000	0.83	TT/DP	0	0.79	0.14	$439,885	$153,026	$1,078,179
Total:								10.88	8.10	$1,754,007	$608,739	$75,117

Wastewater Treatment Codes:

HT=Holding tank	OP=Open pond	AS=Air stripper
BI=Biological treatment	EQ=Equalization pond	DP=Discharge to a POTW
CL=Clarifier	TT=Treatment tank	O=Other
SS=Steam stripper	OF=Offsite destruction	

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Date: February 15, 2000

Subject: MACT Floor, Regulatory Alternatives, and Nationwide Impacts for Storage Tanks at Coatings Manufacturing Facilities
Miscellaneous Organic NESHAP
EPA Project No. 99-607; MRI Project No. 104803.1.049

From: David Randall
Jennifer Fields

To: MON Project File

I. Introduction

This memorandum describes existing and new source MACT floors and regulatory alternatives for storage tanks at coatings manufacturing facilities. This memorandum also presents the resulting emission reductions and costs for the regulatory alternatives.

II. Change to Reported Data

After reviewing the data, we made two changes to the original compilation of data obtained from facilities in response to the ICR. Tank 9 at facility 124 is a vertical tank that contains three HAPs, and the facility reported partial pressures for each HAP that totaled 3.34 psia. However, the reported partial pressures were really vapor pressures. As a result, we assumed the tank contained only the HAP with the highest partial pressure (vinyl acetate) and the partial pressure was assumed to be that of vinyl acetate, 1.78 psia. The other constituents were neglected.

The second change was to a horizontal tank. Tank T-6100-1 at facility 77 had three reported constituents. The weight percent was given for two of those constituents and the third, methyl ethyl ketone, was assumed to be the balance of the mixture.

III. MACT Floor and Regulatory Alternatives

A. Existing Sources

The MACT floor of no control is unchanged from the previous analysis.[1] However, after reviewing the data, we are recommending different regulatory alternatives above the floor. These alternatives are summarized in Table 1. The control requirement in the previous analysis was 80 percent.[1] We believe 90 percent (or the use of an IFR or EFR) would be more appropriate because it is consistent with the level we are recommending for new sources. We are also recommending a partial pressure cutoff of 1.9 psia instead of 3.0 psia for the first option because there are only three tanks with partial pressures greater than 3.0, and, as a result of the correction to the database noted above, they are all well above 3.0. Furthermore, 1.9 psia is consistent with the maximum true vapor pressure cutoff used in many other rules. The second regulatory alternative has a lower capacity cutoff of 10,000 gal and the same partial pressure cutoff of 1.9 psia. Only option 1 has a reasonable cost. This is not surprising given that the HON analysis did not find costs to be reasonable for tanks below 20,000 gal, and other rules require control for such tanks only when the control level is determined to be the MACT floor. The costs, emission reductions, and cost effectiveness are summarized in Table 2 and discussed in detail in sections IV and V of this memorandum.

TABLE 1. MACT FLOOR AND REGULATORY ALTERNATIVES FOR EXISTING AND NEW FACILITIES

Regulatory alternative	Control requirement	Applicability cutoffs	
		Tank size, gal	Partial pressure, psia
Existing sources			
MACT floor	None	None	None
Option 1	IFR, EFR, or 90% reduction	$20,000	$1.9
Option 2		$10,000	$1.9
New sources			
MACT floor	IFR, EFR, or 90% reduction	$25,000 and $20,000 to <25,000	$0.1 $1.5

B. <u>New Sources</u>

In the previous analysis, the MACT floor for new sources was determined to be an 80 percent reduction for tanks with a capacity $10,000 gal that store material with a HAP partial pressure $0.2 psia.[2] The floor was based on the control achieved at a PPG Industries facility in Cleveland, Ohio. This facility uses a thermal incinerator to control emissions from several tanks storing a mixture of glycol ether and methyl isobutyl ketone. According to a representative from PPG, the HAP partial pressure of this mixture is 0.02 psia, not 0.2 psia.[3] This value is below the de minimis of 0.05 psia that has been applied in many other rules. Therefore, we believe the floor should not be based on the data for these tanks.

One other coatings manufacturing facility controls emissions from storage tanks. This facility, Torrance Coatings and Resins in Torrance, California, uses a carbon adsorber to reduce HAP emissions from several tanks by 90 percent. One tank stores glycol ethers; based on the information above, we assumed the HAP partial pressure for this tank is below the de minimis

TABLE 2. IMPACTS OF REGULATORY ALTERNATIVES FOR EXISTING SOURCES

Regulatory alternative	Number of affected tanks	Total capital investment, $	Total annual cost, $/yr[a]	Emission reduction, Mg/yr[b]	Cost effectiveness, $/Mg	
					Relative to floor	Incremental
MACT floor	0	0	0	0	N/A	N/A
Option 1	6	62,200	12,300	2.53-4.63	2,700 - 4,900	2,700-4,900
Option 2	14	236,000	161,500	7.52-13.5	12,000-21,500	16,800-29,900

[a] Variations in emission reductions due to differences in tank color affect the recovery credit, which, in turn, results in slight differences in the TAC; this table presents the midpoint of the range of the TAC values.
[b] The range of emission reductions is based on different assumptions regarding the color of the tank.

level. Two tanks store material that is 45 percent xylene by weight. Based on the procedures described in section IV.A. of this memorandum for calculating HAP partial pressure when part of the composition is unknown, these tanks also fall below the de minimis threshold. A 25,000 gal tank storing 100 percent xylene, however, has a partial pressure of 0.11 psia, and a 20,000 gal tank storing 100 percent methyl ethyl ketone has a partial pressure of 1.5 psia (assuming a temperature of 20EC for both tanks). All of these tanks are the best performing tanks because they are all controlled to the best level of control in the source category. Applicability cutoffs are established based on the smallest tanks storing material with the lowest partial pressures (above the de minimis). Therefore, the MACT floor for new sources consists of 90 percent control for storage tanks with a capacity $25,000 gal that store a material with a HAP partial pressure $0.1 psia and 90 percent control for tanks with a capacity $20,000 gal and <25,000 gal that store material with a HAP partial pressure $1.5 psia. We did not develop regulatory alternatives that are more stringent than the MACT floor because the floor is already more stringent than the first regulatory alternative for existing sources, and costs were not reasonable for any more stringent regulatory alternatives.

IV. Emission Calculations and Impacts

Emission estimates were not requested as part of the ICR. Therefore, we estimated emissions from each tank based on other information about the tanks that was provided in the ICR responses. This information included the type of tank, the types of HAP(s) stored in the tank, the annual throughput, and either the HAP weight percent in the liquid or the HAP partial pressure. For many of the tanks we did not have the complete composition of the stored material. Therefore, we could not use standard AP-42 procedures to estimate uncontrolled emissions from these tanks. To approximate the emissions from each tank we obtained or estimated the applicable HAP partial pressure(s) and multiplied these values by the average ratio of HAP emissions per unit of partial pressure (i.e., one psia) that was developed for storage tanks at chemical manufacturing facilities in the MON source category. Because this approach gives only a rough estimate of emissions (in fact, it appears to overestimate the emissions), we also used the AP-42 procedures (i.e., the TANKS 4 program) to estimate emissions for the few tanks that would be subject to control under the regulatory alternatives. All of these tanks stored material that was 100 percent HAP. Both procedures are described in more detail below.

A. Nationwide Uncontrolled Emissions

As noted above, we developed an initial estimate of HAP uncontrolled emissions for each tank based on the HAP partial pressure for that tank and an average emission factor that was developed using data for storage tanks at chemical manufacturing facilities. For vertical tanks, this factor was 573.5 lb HAP emitted per psia, and for horizontal tanks, the factor was 1,220 lb HAP emitted per psia.[4] To use the factors, we needed the HAP partial pressure for each tank. If a facility reported the partial pressure, we used it in the calculation. However, if a facility reported the HAP weight percent instead of the partial pressure, we calculated the HAP mole fraction in the liquid and used Raoult's law to estimate the HAP partial pressure, as follows:

$$HAP_{pp} = X_{HAP} \times HAP_{vp} \qquad \text{Eq. 1}$$

For many tanks we did not know the non-HAP composition of the stored material. Therefore, we calculated the HAP mole fraction using the following equation:

$$X_{hap} = \frac{HAP_{moles}}{HAP_{moles} + UNKNOWN_{moles}} \qquad \text{Eq. 2}$$

The molar flow rate of unknown material, assuming it is an organic compound with a molecular weight of 100, could be calculated using the following equation:

$$UNKNOWN_{moles} = \frac{100 - HAPwt\%}{100} \times \frac{1995\,throughput}{MW} \times Density_{mix} \qquad \text{Eq. 3}$$

We developed a similar equation to estimate the molar flow rate of HAP, as follows:

$$HAP_{moles} = \frac{1995\,throughput}{MW_{hap}}\ x\ \frac{HAPwt\%}{100}\ x\ Density_{mix} \qquad \text{Eq. 4}$$

Because we are interested in the HAP mole fraction, not the number of moles, we substituted equations 3 and 4 into equation 2 and simplified to obtain the following equation:

$$X_{HAP} = \frac{\dfrac{HAPwt\%/100}{MW_{hap}}}{\dfrac{HAPwt\%/100}{MW_{hap}} + \dfrac{(100 - HAPwt\%)/100}{100}} \qquad \text{Eq. 5}$$

For any tank with an unspecified HAP and thus, unknown molecular weight, we used 100 for MWhap in this equation. We then used the calculated mole fraction and the vapor pressure of the HAP (at 20EC) in Equation 1 to estimate the HAP partial pressure. If the tank contained multiple HAP, we repeated this calculation for each HAP and summed the resulting values to estimate the total HAP partial pressure for the tank. Finally, we multiplied the total HAP partial pressure by the appropriate emission factor to estimate the uncontrolled emissions:

$$UNC_{HAP\_vert} = HAP_{pp} \times 573.5 \qquad \text{Eq. 6}$$

$$UNC_{HAP\_horiz} = HAP_{pp} \times 1{,}220 \qquad \text{Eq. 7}$$

Attachment 1 shows reported data and HAP characteristics for a sample of the tanks in the source category (i.e., the tanks that meet the applicability cutoffs for the regulatory alternatives). The calculated mole fractions, partial pressures, and uncontrolled emissions for each tank are tabulated in attachment 2. Nationwide uncontrolled emissions are estimated to be 142,100 lb/yr (64.5 Mg/yr).

B. Baseline Emissions

Baseline emissions were calculated based on the uncontrolled emissions and the reported control efficiency (CE) for existing control devices as follows:

$$Baseline = UNC_{HAP} \times \frac{100-CE}{100} \qquad \text{Eq. 8}$$

The resulting baseline emissions for each tank are presented in Attachment 2. The nationwide baseline emissions are estimated to be 140,600 lb/yr (63.8 Mg/yr).

C. Emission Impacts of Regulatory Alternatives

The procedures described above used average, or model, characteristics to estimate HAP partial pressures and emissions. This is a reasonable approach to estimate nationwide emissions, but it may not represent individual tanks very well. As shown in Attachment 2, only a few storage tanks meet the capacity and partial pressure cutoffs of the regulatory alternatives. Therefore, in an effort to develop better estimates of the regulatory impacts, we decided to conduct site-specific analyses using EPA's TANKS 4.0 program for those tanks in Attachment 2 with capacities $10,000 gal and HAP partial pressures $1.9 psia (as well as some with lower partial pressures that could exceed the cutoff in locations with a warm climate). The tanks for which the analyses were conducted are listed in Attachment 3.

1. Maximum True Vapor Pressure. The first step in the analysis was to determine which of the tanks in Attachment 3 have a HAP maximum true vapor pressure (i.e., the HAP partial pressure at the highest monthly average liquid surface temperature) $1.9 psia. This was a straightforward exercise for tanks storing only one compound at ambient conditions. Tank 16100-1 at Facility 77, however, stored a mixture of three HAPs, and it appears to be heated. One of the HAPs, methyl ethyl ketone, had a reported HAP partial pressure of 2.53 psia. Because a pressure was given for only one of the components, however, it was assumed to be the

vapor pressure. The tank also was reported to be a constant temperature tank. Using the TANKS 4.0 program, the temperature of the tank at which the vapor pressure of methyl ethyl ketone was 2.53 psia was determined to be 91EF. At this temperature, the vapor pressure for the mixture was calculated by TANKS to be 1.98 psia. The highest monthly average liquid surface temperatures for each tank, and the corresponding HAP partial pressures at these temperatures, are shown in Attachment 3. Fourteen of these tanks have maximum true vapor pressures $1.9 psia.

2. Uncontrolled Emissions. The second step in the analysis was to determine the uncontrolled emissions. In addition to the maximum true vapor pressure, important parameters in this calculation include the annual throughput, the tank dimensions, the maximum and average liquid height, the shell and roof color and shading, breather vent settings, tank condition, roof type and slope, and if the tank is heated or underground. The facilities provided annual throughputs in the ICR responses; all other parameters were estimated. The maximum liquid height was assumed to be the height of the tank. The average liquid height was assumed to be approximately 60 percent of the tank height. The facilities reported the tank capacity in the ICR responses, and dimensions of the tank were calculated using the following equation:

$$Volume = \frac{\pi D^2}{4} H \qquad \text{Eq. 9}$$

For vertical tanks, the height was assumed to be approximately equal to the diameter. The height (length) was assumed to be twice the diameter for horizontal tanks. Default values provided in the TANKS program (and listed in Attachment 4) were used for the remaining parameters.

Of the parameters for which default characteristics were used, the one with the greatest impact on emissions is the shell color and shading. Because we do not know the actual tank colors, we decided to develop a range of emissions based on three likely colors. The default, white, provided the lowest emissions, light grey provided an intermediate value, and aluminum provided the highest emissions. The range of estimated uncontrolled emissions for the 14 tanks with maximum true vapor pressures $1.9 psia are provided in Attachment 3. Copies of the TANKS 4.0 reports for tank F26T#8 are also provided in Attachment 3.

3. Emissions Reductions. The final step in the impacts analysis was to estimate the emissions reductions achieved by the regulatory alternatives. All 14 tanks in the analysis are currently uncontrolled. Therefore, emission reductions are equal to 90 percent of the uncontrolled emissions under both regulatory alternatives. The resulting reductions for each tank are shown in Attachment 3. The total reductions range from 5,581 to 10,212 lb/yr (2.53 to 4.63 Mg/yr) under regulatory alternative 1 and from 16,583 to 29,705 lb/yr (7.52 to 13.5 Mg/yr) under regulatory alternative 2.

V. Cost Calculations and Impacts

A. Internal Floating Roofs

The base costs for internal floating roofs were calculated in July 1989 dollars using procedures in the HON BID.[5] These costs were then escalated to February 1999 dollars. The Access module used to estimate the costs is presented in Attachment 5, and the elements in the module are described in this section.

Before an internal floating roof can be installed, the tank must be cleaned, emptied, and degassed. During degassing, the tank is emptied of all VOC vapors by replacing the VOC-laden air in the tank with fresh air. The cost of cleaning and degassing the tank was calculated as follows:

$$Degas = 7.61 \times Tank\ size^{0.5132} \qquad \text{Eq. 10}$$

To determine the cost of the internal floating roof installation, the tank diameter is needed. It was calculated as follows:

$$Tank\ diameter = \frac{Tank\ size^{1/3}}{7.481} \qquad \text{Eq. 11}$$

where 7.481 is the number of gallons in a cubic foot.

The cost of installing an internal floating roof depends on the type of deck and seal system selected. The following equation estimates the cost of installing a new bolted, floating deck having a liquid-mounted primary seal and controlled deck fittings.

$$Floating\ roof = 509 \times Tank\ diameter + 1160 \qquad \text{Eq. 12}$$

The above equation includes the cost of cutting vents or openings necessary for modifying the tank. Therefore, the total capital investment (TCI) is the sum of the costs for the tank degassing and the new floating roof:

$$TCI = \left(Degas + Floating\ roof\right) \qquad \text{Eq. 13}$$

The base TCI was escalated to first quarter 1999 dollars using the Chemical Engineering Plant Cost Indexes for February 1999 and July 1989 (i.e., 387.9/356.0).[6,7]

The annual cost without product recovery can then be calculated by summing the annualized capital cost, operating costs and costs for taxes, insurance, and administration. Assuming an equipment life of 15 years and an interest rate of 7 percent, the capital recovery factor equals 0.1098. Operating costs include the yearly maintenance costs and an inspection charge, which is estimated to be equal to 5 and 1 percent of the TCI, respectively. Taxes, insurance, and administration are assumed to be equal to 4 percent of the TCI. The total annual cost (TAC) also accounts for the value of any recovered product. Product recovery credit is calculated by multiplying the market value of the chemical by the emission reduction achieved by the tank improvements. The market value of recovered product was assumed to be \$0.10/lb. This is the standard value used in the OAQPS procedures. The equation below summarizes the calculation of total annual cost. The first term represents the capital recovery costs, and costs for taxes, insurance, and administration, and the second term represents recovery credit.

$$TAC = (\text{TCI} \times 0.2098) - (\text{Emission reduction} \times 0.1) \qquad \text{Eq. 14}$$

B. Condensers

We estimated the cost for condensers using an algorithm based on the standard OAQPS procedures.[8] A copy of the algorithm for tank F72TTank#21 (i.e, the horizontal tank storing methylene chloride, the highest HAP partial pressure for a horizontal tank) is presented in attachment 6. We made two modifications from the standard OAQPS procedures to account for the fact that the gas stream flowrate varies. The first change was to the HAP load calculations. We used the standard procedures to estimate the emissions that occur during filling, and these flows and emissions were used to size the unit. However, because we estimated breathing losses using the TANKS program, we also included these emissions in the calculation of the recovery credit. The second change was to the electricity use and cost. We used the standard procedures to estimate electricity consumption during filling events. At other times, the heat load and, thus, the power requirements for the refrigeration unit would be lower, but how much lower is unknown. Small requirements for a coolant circulating pump would also still be necessary. Therefore, we assumed the electricity requirement at all times except during filling events is equal to 10 percent of the requirement during filling events.

C. Costs and Cost Effectiveness for the Regulatory Alternatives

The costs and cost effectiveness for the installation of a floating roof on all of the vertical tanks are included in Attachment 7. Tables 1 and 2 in Attachment 7 show the vertical tanks that meet the applicability cutoffs for regulatory alternative 1. Depending on the color of the tank, the average cost effectiveness ranges from \$2,355/ton of HAP removed to \$4,476/ton of HAP removed (\$2,596 to \$4,934/Mg). Tables 3 and 4 in Attachment 7 show the vertical tanks that meet the applicable cutoffs for regulatory alternative 2. The average cost effectiveness for these tanks ranges from \$2,564/ton of HAP removed to \$5,114/ton of HAP removed (\$2,826 to \$5,637/Mg), depending on the tank color.

Control costs for horizontal tanks were estimated using the condenser algorithm because floating roofs are not applicable for these tanks. Attachment 8 presents the costs and cost effectiveness for all of the horizontal tanks that meet the applicability cutoffs for regulatory alternative 2 (no horizontal tank meets the cutoffs for regulatory alternative 1). The costs are the same for all of the tanks because we used the methylene chloride tank as a model for all of the others. Although the other tanks store different materials and have different throughputs, it is unlikely that a site-specific analysis for those tanks would result in significantly lower TACs, and they could be higher. The annual emission reductions also are similar for all of the tanks. Therefore, the average cost effectiveness values range from approximately $19,000/ton of HAP removed to $32,000/ton of HAP removed ($21,400 to $35,800/Mg), depending on the color of the tanks.

VI. References

1. Memorandum from C. Zukor and R. Howle, Alpha-Gamma Technologies, Inc., to Miscellaneous Organic NESHAP Project File. June 22, 1999. Existing Source MACT Floors for Surface Coating Manufacturing Processes.

2. Memorandum from C. Zukor and R. Howle, Alpha-Gamma Technologies, Inc., to Miscellaneous Organic NESHAP Project File. June 7, 1999. New Source MACT Floors for Surface Coating Manufacturing Processes.

3. Telecon. C. Zukor, Alpha-Gamma Technologies, Inc., with D. Mazzocco, PPG Industries, May 25 and June 6, 1999. Discussion of HAP partial pressures for controlled tanks.

4. Memorandum summarizing storage tank emissions for chemical manufacturing facilities (to be written).

5. U. S. Environmental Protection Agency. Hazardous Air Pollutant Emissions From Process Units in the Synthetic Organic Chemical Manufacturing Industry–Background Information for Proposed Standards. Research Triangle Park, North Carolina, Office of Air Quality Planning and Standards. EPA Publication No. EPA-453/D-92-016b. November 1992.

6. Economic Indicators. Chemical Engineering. Plant Cost Index for February 1999. June 1999. Page 170.

7. Economic Indicators. Chemical Engineering. Plant Cost Index for July 1989. October 1989. Page 230.

8. U. S. Environmental Protection Agency. OAQPS Control Cost Manual. Fourth Edition. EPA Publication No. EPA-450/3-90-006. Chapter 8. Refrigerated Condensers.

Attachment 1
Sample of Reported Data and HAP Characteristics

HORIZONTAL TANKS THAT MEET APPLICABILITY CUTOFFS FOR REGULATORY ALTERNATIVES

Facility #	Tank ID	Legal Owner	City	State	Tank Capacity	Tank Throughput	Name of HAP	HAP MW	HAP Vapor Pressure	Reported HAP Partial Pressure	HAP Weight Percent
72	Tank #21	Jack Day Stritt	Carpentersville	IL	12,000	33,304	Methylene Chloride	84.93	6.73		100
77	T-6100-1	BASF Corporation	Belvidere	NJ	12,500	498,744	Methyl Ethyl Ketone	72.10	2.53	2.53	67.82
77	T-6100-1	BASF Corporation	Belvidere	NJ	12,500	498,744	Toluene	92.13	0.05		10.25
77	T-6100-1	BASF Corporation	Belvidere	NJ	12,500	498,744	Xylenes	106.16	0.02		21.93
4	T033	Evan Williams	Columbus	OH	12,000	540,000	Hexane	86.18	2.33		100
59	Tank 10	E. I. Du Pont De Nemours & Co. Inc.	Fort Madison	IA	12,000	65,000	Methanol	32.04	1.87		100
112	HS-3103	Lord Corporation	Saegertown	PA	15,000	134,829	Methanol	32.04	0.00	0	100
112	HS-3147	Lord Corporation	Saegertown	PA	15,000	31,859	Methyl chloroform	133.42	0.00	0	100

VERTICAL TANKS THAT MEET APPLICABILITY CUTOFFS FOR REGULATORY ALTERNATIVES

Facility #	Tank ID	Legal Owner	City	State	Tank Capacity	Tank Throughput	Name of HAP	HAP MW	HAP Vapor Pressure	Reported HAP Partial Pressure	HAP Weight Percent
51	15	Vogel Paint & Wax Co., Inc.	Orange City	IA	11,000	22,705	Methylene Chloride	84.93	6.73		100
34	# 8	Pierce & Stevens Corporation	Buffalo	NY	20,000	62,700	Methylene Chloride	84.93	6.73		100
107	101	Ashland Chemical Co.	Ashland	OH	11,000	134,100	Hexane	86.18	2.35	2.35	0
34	# 14	Pierce & Stevens Corporation	Buffalo	NY	20,000	87,400	Hexane	86.18	2.33		100
34	# 13	Pierce & Stevens Corporation	Buffalo	NY	20,000	87,400	Hexane	86.18	2.33		100
32	T002	Sovereign Speciality Chemicals	Akron	OH	15,000	9,500	Hexane	86.18	2.33		100
34	# 7	Pierce & Stevens Corporation	Buffalo	NY	20,000	98,800	Methyl chloroform	133.42	2.02		100
25	#22	Peerless Coatings, Inc.	Cullman	AL	15,000	9,914	Methanol	32.04	1.90	1.9	
99	B(S)ST-12	Lilly Industries, Inc.	High Point	NC	20,000	512,324	Methanol	32.04	1.87		100
98	AST 22	Lilly Industries, Inc.	High Point	NC	20,000	347,798	Methanol	32.04	1.87		100

Attachment 2
Nationwide Uncontrolled Emissions

ORIGINAL DATA FOR HORIZONTAL TANKS

Facility #	Tank ID	Tank Capacity	1995 Tank Throughput	Reported HAP Partial Pressure (psia)	HAP Weight Percent	HAP PP (psia)	HAP mole fraction	Uncontrolled HAP Emissions (lb/yr)	Baseline HAP Emissions (lb/yr)	Control Device	Tank Control Device Efficiency
72	Tank #21	12,000	33,304		100	6.73	1.00	8,208.59	8,208.59		
4	T033	12,000	540,000		100	2.33	1.00	2,837.87	2,837.87		
112	HS-3147	15,000	31,859	0	100	2.02	1.00	2,469.91	2,469.91		0
59	Tank 10	12,000	65,000		100	1.87	1.00	2,277.48	2,277.48		
112	HS-3103	15,000	134,829	0	100	1.87	1.00	2,277.48	2,277.48		0
34	# 3	12,500	79,000		100	1.35	1.00	1,648.72	1,648.72		
36	TS-72	10,500	584,687	1.35	100	1.35	1.00	1,648.72	1,648.72		
54	006	12,000	200,300		100	1.35	1.00	1,648.72	1,648.72		
66	ESST13	10,000	123,100		100	1.35	1.00	1,648.72	1,648.72		
73	10301	10,300	16,000		100	1.35	1.00	1,648.72	1,648.72		
94	7	10,157	155,000		100	1.35	1.00	1,648.72	1,648.72		
112	HS-3101	15,000	40,277	0	100	1.35	1.00	1,648.72	1,648.72		0
115	T1	11,000	109,000	0	100	1.35	1.00	1,648.72	1,648.72		0
59	Tank 4	12,000	791,000	1.21	100	1.14	1.07	1,394.57	1,394.57		
77	T-6100-1	12,500	498,744	2.53	100	1.08	1.06	1,313.66	1,313.66		
54	013	12,000	20,400		100	0.69	1.03	845.08	845.08		
73	11200	11,200	120,910		80.5	0.51	0.86	627.55	627.55		
56	Tank 11-18	15,000	158,000		51	0.50	0.59	615.02	615.02		
72	Tank #22	12,000	28,906		39	0.49	0.47	598.56	598.56		
4	T034	12,000	160,000		100	0.42	1.00	514.84	514.84		
15	STK112	30,000	340,863		100	0.42	1.00	514.84	514.84		
15	STK113	30,000	340,863		100	0.42	1.00	514.84	514.84		
15	STK114	15,000	340,863		100	0.42	1.00	514.84	514.84		
15	STK115	15,000	340,863		100	0.42	1.00	514.84	514.84		
42	26-T-326	14,000	33,799		100	0.42	1.00	514.84	514.84		

ORIGINAL DATA FOR HORIZONTAL TANKS (continued)

Facility #	Tank ID	Tank Capacity	1995 Tank Throughput	Reported HAP Partial Pressure (psia)	HAP Weight Percent	HAP PP (psia)	HAP mole fraction	Uncontrolled HAP Emissions (lb/yr)	Baseline HAP Emissions (lb/yr)	Control Device	Tank Control Device Efficiency
54	004	12,000	273,810		100	0.42	1.00	514.84	514.84		
61	TF 1	25,098	655,318		100	0.42	1.00	514.84	514.84		
61	TF 2	25,098	655,318		100	0.42	1.00	514.84	514.84		
61	TF 3A	12,549	427,984		100	0.42	1.00	514.84	514.84		
61	TF 4B	10,011	440,953		100	0.42	1.00	514.84	514.84		
72	Tank # 9	12,000	74,004		100	0.42	1.00	514.84	514.84		
77	T-6110	25,000	221,708		100	0.42	1.00	514.84	514.84		
94	9	10,157	81,400		100	0.42	1.00	514.84	514.84		
115	T3	11,000	80,000	0	100	0.42	1.00	514.84	514.84		0
73	17000	17,000	23,100		99.9	0.42	1.00	514.37	514.37		
66	ESST16	10,000	119,900		34	0.38	0.39	462.99	462.99		
66	ESST20	10,000	119,900		34	0.38	0.39	462.99	462.99		
72	Tank #12	12,000	64,774		21	0.35	0.27	424.50	424.50		
56	Tank 19-23	15,000	82,000		40	0.32	0.45	385.29	385.29		
61	TF 5A	12,549	17,371		69	0.30	0.71	364.13	364.13		
61	TF 5B	12,549	17,371		69	0.30	0.71	364.13	364.13		
34	# 1	12,500	12,800		100	0.29	1.00	349.95	349.95		
54	001	12,000	36,670		100	0.29	1.00	349.95	349.95		
59	Tank 12	12,000	90,000		100	0.29	1.00	349.95	349.95		
78	RR-3	10,000	254,000		100	0.29	1.00	349.95	349.95		
112	HS-3040	12,000	132,587	0	100	0.29	1.00	349.95	349.95		0
112	HS-3041	12,000	132,578	0	100	0.29	1.00	349.95	349.95		0
115	T5	11,000	15,000	0	100	0.29	1.00	349.95	349.95		0
61	TF 6D	10,011	26,665		65	0.28	0.67	344.13	344.13		
61	TF 7B	12,549	29,665		65	0.28	0.67	344.13	344.13		

ORIGINAL DATA FOR HORIZONTAL TANKS (continued)

Facility #	Tank ID	Tank Capacity	1995 Tank Throughput	Reported HAP Partial Pressure (psia)	HAP Weight Percent	HAP PP (psia)	HAP mole fraction	Uncontrolled HAP Emissions (lb/yr)	Baseline HAP Emissions (lb/yr)	Control Device	Tank Control Device Efficiency
61	TF 8A	12,549	29,665		65	0.28	0.67	344.13	344.13		
61	TF 8B	12,549	29,665		65	0.28	0.67	344.13	344.13		
15	STK106	30,000	920,435		57	0.25	0.59	303.74	303.74		
15	STK108	30,000	920,435		57	0.25	0.59	303.74	303.74		
21	201	17,000	407,155		55.38	0.24	0.57	295.50	295.50		
21	202	17,000	407,000		55.38	0.24	0.57	295.50	295.50		
21	203	17,000	461,234		52.36	0.23	0.54	280.07	280.07		
21	204	17,000	425,000		52.36	0.23	0.54	280.07	280.07		
15	STK101A	30,000	903,871		52	0.23	0.54	278.23	278.23		
15	STK102	30,000	697,470		52	0.23	0.54	278.23	278.23		
15	STK105	30,000	697,470		52	0.23	0.54	278.23	278.23		
14	TK103	30,000	4,695,800		50	0.22	0.52	267.97	267.97		
14	TK104	30,000	4,695,800		50	0.22	0.52	267.97	267.97		
61	75	20,079	271,259		45	0.20	0.47	242.16	242.16		
61	TF 4A	15,016	20,787		45	0.20	0.47	242.16	242.16		
61	TF 7A	12,549	488,265		45	0.20	0.47	242.16	242.16		
15	STK101B	30,000	903,871		38	0.17	0.40	205.68	205.68		
42	26-T-321	14,000	343,682		90	0.16	0.88	194.39	194.39		
73	17001	17,000	99,000		98.9	0.12	0.97	150.36	150.36		
15	STK104	30,000	727,526		27	0.12	0.29	147.48	147.48		
77	T-6030-2	12,500	156,764		100	0.11	1.00	135.84	135.84		
115	T2	11,000	50,000	0	100	0.11	1.00	135.84	135.84		0
15	STK103	30,000	859,851		24	0.11	0.26	131.42	131.42		
72	Tank #10	12,000	85,138		24	0.09	0.25	109.94	109.94		
53	S16 Xylene	10,000	20,100		80.5	0.09	0.80	108.06	108.06		

ORIGINAL DATA FOR HORIZONTAL TANKS (continued)

Facility #	Tank ID	Tank Capacity	1995 Tank Throughput	Reported HAP Partial Pressure (psia)	HAP Weight Percent	HAP PP (psia)	HAP mole fraction	Uncontrolled HAP Emissions (lb/yr)	Baseline HAP Emissions (lb/yr)	Control Device	Tank Control Device Efficiency
94	8	10,157	28,300		19	0.09	0.20	104.48	104.48		
56	Tank 1-10	10,000	53,000		5.7	0.08	0.09	103.40	103.40		
54	008	12,000	253,700		3	0.08	0.03	98.32	98.32		
66	ESST15	10,000	269,400		49	0.06	0.47	71.60	71.60		
66	ESST52	10,000	269,400		49	0.06	0.47	71.60	71.60		
15	STK107	30,000	98,668		7	0.03	0.08	38.89	38.89		
53	S18 Wash Solve	10,000	100,000		20	0.02	0.19	25.89	25.89		
53	S17 Isophorone	10,000	104,400		100	0.01	1.00	10.38	10.38		
42	26-T-328	14,000	522,297		100	0.00	1.00	1.42	1.42		
42	26-T-329	14,000	511,344		100	0.00	1.00	1.42	1.42		
59	Tank 1	12,000	138,000		100	0.00	1.00	1.42	1.42		
102	312	12,000	93,435		100	0.00	1.00	1.42	1.42		
102	318	12,000	158,489		100	0.00	1.00	1.42	1.42		
115	T4	11,000	17,000	0	100	0.00	1.00	1.42	1.42		0
66	ESST19	10,000	135,000		100	0.00	1.00	1.42	1.42		
53	R7 R-3507 Resin	10,000	70,700		6	0.00	0.04	0.46	0.46		
53	S15 Solvent 150	10,000	230,800		9.9	0.00	0.08	0.29	0.29		
53	R8 R-4521 Resin	10,000	179,600		13.5	0.00	0.14	0.19	0.19		
							TOTALS	56,892.93	56,892.93		

ORIGINAL DATA FOR VERTICAL TANKS

Facility #	Tank ID	Tank Capacity	1995 Tank Throughput	Reported HAP Partial Pressure (psia)	HAP Weight Percent	HAP mole fraction	Calculated HAP PP (psia)	Uncontrolled HAP Emissions (lb/yr)	Control Device	Tank Control Device Efficiency	Baseline HAP Emissions (lb/yr)
34	# 8	20,000	62,700		100	1.00	6.73	3,859			3,858.68
51	15	11,000	22,705		100	1.00	6.73	3,859			3,858.68
107	101	11,000	134,100	2.35	0	0.00	2.35	1,348			1,347.73
32	T002	15,000	9,500		100	1.00	2.33	1,334			1,334.02
34	# 13	20,000	87,400		100	1.00	2.33	1,334			1,334.02
34	# 14	20,000	87,400		100	1.00	2.33	1,334			1,334.02
4	T001	12,000	590,000		100	1.00	2.02	1,161			1,161.05
34	# 7	20,000	98,800		100	1.00	2.02	1,161			1,161.05
25	#22	15,000	9,914	1.9		0.00	1.90	1,090			1,089.65
42	39-T-313	17,000	252,183		100	1.00	1.87	1,071			1,070.59
51	16	11,000	39,946		100	1.00	1.87	1,071			1,070.59
85	12	11,700	106,879		100	1.00	1.87	1,071			1,070.59
98	AST 22	20,000	347,798		100	1.00	1.87	1,071			1,070.59
99	B(S)ST-12	20,000	512,324		100	1.00	1.87	1,071			1,070.59
106	6	15,547	500,000	0	100	1.00	1.87	1,071			1,070.59
125	1	10,528	113,413	1.83		0.00	1.83	1,050		0	1,049.51
124	9	20,000	58,770	1.78		0.00	1.78	1,021		0	1,020.83
101	T507	12,000	210,904	1.61		0.00	1.61	923			923.34
29	6	12,000	32,000		60	0.82	1.54	882	Carbon tray	30	617.51
107	102	11,000	127,000	1.4	0	0.00	1.40	803			802.90
125	6	10,528	135,089	1.4		0.00	1.40	803		0	802.90
126	27	20,000	591,534	1.4		0.00	1.40	803		0	802.90
35	007A	30,000	140,675	1.37		0.00	1.37	786	Vapor condenser		785.70
9	B	10,000	75,000		100	1.00	1.35	775			775.03
9	E	10,000	75,000		100	1.00	1.35	775			775.03

ORIGINAL DATA FOR VERTICAL TANKS (continued)

Facility #	Tank ID	Tank Capacity	1995 Tank Throughput	Reported HAP Partial Pressure (psia)	HAP Weight Percent	HAP mole fraction	Calculated HAP PP (psia)	Uncontrolled HAP Emissions (lb/yr)	Control Device	Tank Control Device Efficiency	Baseline HAP Emissions (lb/yr)
29	25	12,000	54,337		100	1.00	1.35	775	Carbon tray	30	542.52
32	T005	15,000	141,300		100	1.00	1.35	775			775.03
39	103	12,000	109,403		100	1.00	1.35	775			775.03
39	195	12,000	109,403		100	1.00	1.35	775			775.03
40	TK60	20,000	30,000		100	1.00	1.35	775	Carbon Absorption	90	77.50
41	7	20,000	37,000		100	1.00	1.35	775			775.03
42	39-T-317	17,000	33,539		100	1.00	1.35	775			775.03
47	2052	20,000	363,591		100	1.00	1.35	775			775.03
51	11	10,500	100,954		100	1.00	1.35	775			775.03
59	Tank 22	18,000	337,000		100	1.00	1.35	775			775.03
64	T-31	30,000	568,800		100	1.00	1.35	775			775.03
65	ESST2	12,600	396,000		100	1.00	1.35	775			775.03
67	S9	12,000	100,300		100	1.00	1.35	775			775.03
68	T015	12,000	131,700		100	1.00	1.35	775			775.03
69	237	10,000	5,100		100	1.00	1.35	775			775.03
70	S-5	10,000	82,700		100	1.00	1.35	775			775.03
84	S-3	12,000	145,812		100	1.00	1.35	775			775.03
85	24	20,000	129,419		100	1.00	1.35	775			775.03
98	AST 24	20,000	317,855		100	1.00	1.35	775			775.03
102	324	11,000	79,284		100	1.00	1.35	775			775.03
119	TNK-00101	20,000	36,167		100	1.00	1.35	775		0	775.03
25	#21	12,000	30,117	1.35		0.00	1.35	774			a774.23
25	#25	15,000	37,647	1.35		0.00	1.35	774			774.23
98	AST 19	20,000	92,132		57.3	0.88	1.32	759			759.36
106	61	282,300	150,000	0	28	0.55	1.02	587			586.98

ORIGINAL DATA FOR VERTICAL TANKS (continued)

Facility #	Tank ID	Tank Capacity	1995 Tank Throughput	Reported HAP Partial Pressure (psia)	HAP Weight Percent	HAP mole fraction	Calculated HAP PP (psia)	Uncontrolled HAP Emissions (lb/yr)	Control Device	Tank Control Device Efficiency	Baseline HAP Emissions (lb/yr)
65	ESST7	12,600	81,700		52	0.77	1.02	585			585.35
42	37-T-306	17,000	643,804		76	0.92	0.97	554			553.84
42	39-T-314	17,000	643,804		76	0.92	0.97	554			553.84
106	23	25,594	300,000	0	100	1.09	0.94	541			540.82
106	64	15,000	300,000	0	54	0.78	0.92	525			524.89
84	L-18	11,000	178,000		55	0.63	0.85	487			487.47
84	L-19	11,000	178,000		55	0.63	0.85	487			487.47
84	L-21	11,000	178,000		55	0.63	0.85	487			487.47
84	L-22	11,000	178,000		55	0.63	0.85	487			487.47
42	39-T-316	17,000	84,000		100	1.07	0.84	481			481.31
32	T004	15,000	23,600		30	0.33	0.77	443			443.07
98	AST 20	20,000	115,165		43.1	0.58	0.71	406			406.26
42	37-T-304	17,000	643,804		71	0.78	0.70	403			402.78
32	T001	15,000	11,600		25.6	0.29	0.66	381			380.65
124	3	14,000	301,770	0.6		0.00	0.60	344		0	344.10
84	R-30	11,000	20,690		100	1.00	0.59	340			339.64
119	TNK-00109	20,000	19,194		40.7	0.48	0.55	314		0	314.36
84	R-29	11,000	20,759		100	1.00	0.54	309			308.60
106	63	15,000	25,000	0	75	0.81	0.53	304			303.52
106	70	28,000	25,000	0	75	0.81	0.53	304			303.52
39	1B102	11,500	106,982		61	0.69	0.52	297			297.39
47	2051	20,000	2,460,143		78	0.84	0.51	290			289.74
102	400	30,000	1,695,000		75	0.76	0.49	282			282.40
102	401	15,000	1,000,000		75	0.76	0.49	282			282.40
102	402	15,000	1,000,000		75	0.76	0.49	282			282.40

ORIGINAL DATA FOR VERTICAL TANKS (continued)

Facility #	Tank ID	Tank Capacity	1995 Tank Throughput	Reported HAP Partial Pressure (psia)	HAP Weight Percent	HAP mole fraction	Calculated HAP PP (psia)	Uncontrolled HAP Emissions (lb/yr)	Control Device	Tank Control Device Efficiency	Baseline HAP Emissions (lb/yr)
106	66	11,100	1,000,000	0	81	0.86	0.48	273			273.36
106	68	15,000	1,000,000	0	81	0.86	0.48	273			273.36
69	251	10,000	131,000		64.7	0.66	0.45	260			259.92
39	1B108	11,500	30,578		46	0.53	0.45	259			259.46
25	#2	15,000	45,475	0.43		0.00	0.43	247			246.61
25	#26	15,000	45,475	0.43		0.00	0.43	247			246.61
35	005A	30,000	1,008,399	0.43		0.00	0.43	247			246.61
125	12	10,364	70,475	0.43		0.00	0.43	247		0	246.61
126	21	30,000	273,140	0.43		0.00	0.43	247		0	246.61
126	23	30,000	1,587,241	0.43		0.00	0.43	247		0	246.61
126	5	11,000	385,241	0.43		0.00	0.43	247		0	246.61
1	V-502	17,000	1,512,000		100	1.00	0.42	242			242.02
1	V-503	17,000	1,512,000		100	1.00	0.42	242			242.02
1	V-504	17,000	1,512,000		100	1.00	0.42	242			242.02
16	T118	21,149	293,720		100	1.00	0.42	242			242.02
32	T003	15,000	59,400		100	1.00	0.42	242			242.02
34	# 18	20,000	168,900		100	1.00	0.42	242			242.02
34	# 19	20,000	168,900		100	1.00	0.42	242			242.02
39	182	22,700	174,979		100	1.00	0.42	242			242.02
39	9B007	24,400	174,979		100	1.00	0.42	242			242.02
41	5	20,000	62,000		100	1.00	0.42	242			242.02
47	3064	30,000	834,800		100	1.00	0.42	242			242.02
51	7	11,000	69,145		100	1.00	0.42	242			242.02
52	3-17	20,000	187,375		100	1.00	0.42	242			242.02
59	Tank 158	30,000	171,000		100	1.00	0.42	242			242.02

ORIGINAL DATA FOR VERTICAL TANKS (continued)

Facility #	Tank ID	Tank Capacity	1995 Tank Throughput	Reported HAP Partial Pressure (psia)	HAP Weight Percent	HAP mole fraction	Calculated HAP PP (psia)	Uncontrolled HAP Emissions (lb/yr)	Control Device	Tank Control Device Efficiency	Baseline HAP Emissions (lb/yr)
59	Tank 159	30,000	784,000		100	1.00	0.42	242			242.02
64	T-5	29,000	918,000		100	1.00	0.42	242			242.02
64	T-7	29,000	918,000		100	1.00	0.42	242			242.02
65	ESST5	12,600	384,000		100	1.00	0.42	242			242.02
66	ESST54	11,000	118,600		100	1.00	0.42	242			242.02
67	S4	25,000	205,800		100	1.00	0.42	242			242.02
68	T014	12,000	618,300		100	1.00	0.42	242			242.02
69	245	10,000	27,300		100	1.00	0.42	242			242.02
70	S-1	10,000	146,600		100	1.00	0.42	242			242.02
84	S-11	12,000	176,730		100	1.00	0.42	242			242.02
85	21	20,000	216,018		100	1.00	0.42	242			242.02
86	TK 91	16,000	45,082		100	1.00	0.42	242			242.02
98	AST 21	20,000	310,946		100	1.00	0.42	242			242.02
102	322	18,000	158,945		100	1.00	0.42	242			242.02
106	12	15,547	100,000	0	100	1.00	0.42	242			242.02
119	TNK-00107	20,000	5,963		100	1.00	0.42	242		0	242.02
107	103	20,000	216,300	0.42	0	0.00	0.42	241			240.87
17	T-203	16,500	304,140		95.7	0.96	0.41	232			232.40
17	T-204	15,000	304,140		95.7	0.96	0.41	232			232.40
14	TK101	20,000	1,058,717		95	0.95	0.40	231			230.82
14	TK102	20,000	1,058,717		95	0.95	0.40	231			230.82
40	TK81	25,000	127,500		80	0.82	0.40	230			230.45
39	9B115	12,000	186,214		55	0.59	0.38	216			216.16
125	10	10,364	44,793	0.35		0.00	0.35	201		0	200.73
125	16	12,199	58,018	0.35		0.00	0.35	201		0	200.73

ORIGINAL DATA FOR VERTICAL TANKS (continued)

Facility #	Tank ID	Tank Capacity	1995 Tank Throughput	Reported HAP Partial Pressure (psia)	HAP Weight Percent	HAP mole fraction	Calculated HAP PP (psia)	Uncontrolled HAP Emissions (lb/yr)	Control Device	Tank Control Device Efficiency	Baseline HAP Emissions (lb/yr)
39	1B113	11,700	67,835		80	0.81	0.34	197			196.71
98	AST 1	12,000	152,304		28.4	0.35	0.32	183			182.66
69	210	11,872	16,000		26.6	0.32	0.29	168			167.65
125	13	12,199	29,971	0.29		0.00	0.29	166		0	166.32
125	15	11,603	69,923	0.29		0.00	0.29	166		0	166.32
127	2	23,000	336,742	0.29		0.00	0.29	166		0	166.32
41	10	20,000	36,600		100	1.00	0.29	165			164.51
42	38-T-310	17,000	83,414		100	1.00	0.29	165			164.51
47	1033	10,000	134,900		100	1.00	0.29	165			164.51
64	T-34	30,000	394,000		100	1.00	0.29	165			164.51
69	239	10,000	12,400		100	1.00	0.29	165			164.51
84	S-4	18,000	285,873		100	1.00	0.29	165			164.51
85	11	10,200	40,158		100	1.00	0.29	165			164.51
106	21	25,912	700,000	0	100	1.00	0.29	165			164.51
1	V-405	10,000	1,480,000		66	0.68	0.29	164			164.12
1	V-401	10,000	1,038,000		63	0.65	0.27	157			157.04
32	T006	15,000	15,600		10.2	0.12	0.27	155			155.35
68	T019	12,000	365,300		100	1.00	0.26	152			151.69
42	32-T-304	17,000	643,804		5	0.14	0.26	151			151.05
106	69	28,000	150,000	0	45	0.51	0.26	149			149.48
107	109	11,000	17,500	0.26	10	0.09	0.26	149			149.11
17	T-201	16,500	271,115		57.5	0.59	0.25	144			143.98
17	T-202	16,500	271,115		57.5	0.59	0.25	144			143.98
1	V-400	10,000	538,000		56	0.58	0.24	140			140.39
1	V-203	10,000	611,000		54	0.56	0.24	136			135.60

ORIGINAL DATA FOR VERTICAL TANKS (continued)

Facility #	Tank ID	Tank Capacity	1995 Tank Throughput	Reported HAP Partial Pressure (psia)	HAP Weight Percent	HAP mole fraction	Calculated HAP PP (psia)	Uncontrolled HAP Emissions (lb/yr)	Control Device	Tank Control Device Efficiency	Baseline HAP Emissions (lb/yr)
21	606	13,500	184,908		53.87	0.56	0.24	135			135.29
64	T-21	30,000	1,346,000		33	0.36	0.23	132			131.73
64	T-22	30,000	1,346,000		33	0.36	0.23	132			131.73
1	V-407	10,000	807,000		52	0.54	0.23	131			130.79
41	164	16,000	856,000		68	0.62	0.22	129			128.91
1	V-403	10,000	324,000		51	0.53	0.22	128			128.38
1	V-506	30,000	1,054,000		50	0.52	0.22	126			125.97
1	V-404	10,000	686,000		49	0.51	0.22	124			123.55
78	SR-3	10,000	357,300		75	0.75	0.22	123			123.33
17	T-223	15,000	280,395		47.9	0.50	0.21	121			120.88
17	T-224	15,000	280,395		47.9	0.50	0.21	121			120.88
1	V-402	10,000	301,000		46	0.48	0.20	116			116.27
1	V-205	10,000	394,000		41	0.43	0.18	104			104.06
1	V-406	10,000	232,000		40	0.42	0.18	102			101.60
1	V-505	30,000	1,628,000		40	0.42	0.18	102			101.60
69	206	11,872	142,500		48.9	0.50	0.17	99			99.44
1	V-204	10,000	264,000		38	0.40	0.17	97			96.68
84	R-36	20,000	134,000		58	0.58	0.17	95			95.35
1	V-207	10,000	485,000		37	0.39	0.16	94			94.22
78	RS-42	10,000	267,000		9	0.12	0.16	93			93.49
79	RS-47	10,000	427,200		9	0.12	0.16	93			93.49
106	1	25,594	400,000	0	63	0.63	0.16	92			92.34
17	T-221	15,000	323,890		34.5	0.36	0.15	88			88.03
17	T-222	15,000	323,890		34.5	0.36	0.15	88			88.03
40	TK15	25,000	172,100		7	0.08	0.14	82	Carbon Absorption	90	8.20

ORIGINAL DATA FOR VERTICAL TANKS (continued)

Facility #	Tank ID	Tank Capacity	1995 Tank Throughput	Reported HAP Partial Pressure (psia)	HAP Weight Percent	HAP mole fraction	Calculated HAP PP (psia)	Uncontrolled HAP Emissions (lb/yr)	Control Device	Tank Control Device Efficiency	Baseline HAP Emissions (lb/yr)
106	55	25,382	3,000,000	0	75	0.73	0.14	82			81.85
106	4	25,594	700,000	0	66	0.63	0.13	77			76.67
106	56	25,382	1,500,000	0	74	0.73	0.13	75			75.39
106	71	28,000	1,500,000	0	74	0.73	0.13	75			75.39
21	602	13,500	357,125		29.09	0.31	0.13	75			74.56
21	603	13,500	350,000		29.09	0.31	0.13	75			74.56
119	TNK-00105	20,000	36,030		100	0.98	0.13	74		0	74.30
86	TK 77	16,000	163,538		100	0.98	0.13	73			72.81
106	18	25,912	1,000,000	0	100	0.98	0.12	71			71.41
106	57	25,382	1,000,000	0	100	0.98	0.12	71			71.41
69	244	10,000	160,800		100	0.98	0.12	71			70.69
13	T-605	15,500	591,487		27	0.29	0.12	69			69.33
13	T-606	15,500	591,487		27	0.29	0.12	69			69.33
107	104	11,000	20,400	0.12	0	0.00	0.12	69			68.82
43	PP-RS21-1325	12,000	2,745,830		44	0.22	0.11	65			65.26
43	PP-RS23-1326	12,000	27,445,830		44	0.22	0.11	65			65.26
39	1B106	11,500	96,159		36	0.37	0.11	65			65.22
29	31	30,000	245,330		100	1.00	0.11	64	Carbon tray	30	44.70
39	9B003	24,400	8,779,814		100	1.00	0.11	64			63.86
40	TK1	25,000	83,100		100	1.00	0.11	64	Carbon Absorption	90	6.39
41	2	20,000	91,000		100	1.00	0.11	64			63.86
42	37-T-303	17,000	692,512		100	1.00	0.11	64			63.86
47	3074	30,000	1,238,716		100	1.00	0.11	64			63.86
51	2	10,500	129,500		100	1.00	0.11	64			63.86
51	3	10,500	129,500		100	1.00	0.11	64			63.86

ORIGINAL DATA FOR VERTICAL TANKS (continued)

Facility #	Tank ID	Tank Capacity	1995 Tank Throughput	Reported HAP Partial Pressure (psia)	HAP Weight Percent	HAP mole fraction	Calculated HAP PP (psia)	Uncontrolled HAP Emissions (lb/yr)	Control Device	Tank Control Device Efficiency	Baseline HAP Emissions (lb/yr)
59	Tank 16	25,000	862,000		100	1.00	0.11	64			63.86
64	T-1	29,000	1,326,900		100	1.00	0.11	64			63.86
64	T-3	29,000	1,326,900		100	1.00	0.11	64			63.86
65	ESST4	12,600	350,400		100	1.00	0.11	64			63.86
66	ESST24	10,000	358,200		100	1.00	0.11	64			63.86
67	S3	25,000	354,700		100	1.00	0.11	64			63.86
70	S-4	10,000	82,600		100	1.00	0.11	64			63.86
76	H 0209	20,975	384,656		100	1.00	0.11	64			63.86
84	S-19	18,000	291,225		100	1.00	0.11	64			63.86
84	S-22	18,000	291,225		100	1.00	0.11	64			63.86
102	320	22,000	537,952		100	1.00	0.11	64			63.86
84	R-20	20,000	20,238		37.8	0.38	0.11	62			62.12
21	604	13,500	400,023		23.15	0.25	0.10	60			59.63
21	605	13,500	433,000		23.15	0.25	0.10	60			59.63
25	#24	15,000	58,804	0.1		0.00	0.10	57			57.35
124	2	14,000	59,090	0.1		0.00	0.10	57		0	57.35
125	11	10,364	124,368	0.1		0.00	0.10	57		0	57.35
126	25	20,000	1,047,455	0.1		0.00	0.10	57		0	57.35
126	3	11,000	37,574	0.1		0.00	0.10	57		0	57.35
126	35L	20,000	429,971	0.1		0.00	0.10	57		0	57.35
127	5	13,000	1,769,285	0.1		0.00	0.10	57		0	57.35
127	6	23,000	2,324,169	0.1		0.00	0.10	57		0	57.35
35	009A	15,000	284,532	0.097		0.00	0.10	56	Vapor condenser		55.63
84	R-27	18,000	111,886		100	1.00	0.09	54			54.31
86	TK 88	16,000	301,506		100	1.00	0.09	54			54.31

ORIGINAL DATA FOR VERTICAL TANKS (continued)

Facility #	Tank ID	Tank Capacity	1995 Tank Throughput	Reported HAP Partial Pressure (psia)	HAP Weight Percent	HAP mole fraction	Calculated HAP PP (psia)	Uncontrolled HAP Emissions (lb/yr)	Control Device	Tank Control Device Efficiency	Baseline HAP Emissions (lb/yr)
65	ESST1	22,000	182,000		21	0.22	0.09	54			54.19
76	H0206	15,000	214,518		85	0.84	0.09	54			53.78
88	7R003	11,500	41,664		85	0.84	0.09	54			53.78
98	AST 18	20,000	128,985		83	0.82	0.09	52			52.45
85	20	20,000	127,153		81.2	0.80	0.09	51			51.26
41	1	20,000	89,000		29	0.29	0.09	50			50.47
39	105	25,000	100,411		30	0.30	0.09	49			49.30
39	9B111	12,000	94,824		28	0.28	0.08	48			47.90
47	1021	10,000	207,967		74	0.73	0.08	47			46.51
106	3	15,547	300,000	0	34	0.33	0.08	45			45.44
106	65	15,000	30,000	0	45	0.44	0.08	45			44.97
39	102	12,000	170,910		27	0.27	0.08	44			44.36
69	207	11,872	399		30	0.05	0.07	42			42.34
39	109	25,000	629,101		25	0.25	0.07	41			41.08
84	R-21	11,000	23,115		25	0.25	0.07	41			41.08
102	301	23,000	240,068		25	0.25	0.07	40			39.68
42	38-T-311	17,000	343,863		24.5	0.24	0.07	39			39.50
69	217	11,872	12,200		25	0.25	0.07	39			39.25
67	S13	12,000	39,100		60	0.59	0.07	37			37.39
106	62	15,000	30,000	0	31	0.30	0.06	35			35.34
39	108	25,000	797,878		21	0.21	0.06	35			34.50
69	204	11,872	81,400		49.9	0.48	0.06	34			34.47
69	218	11,872	6,582		49.9	0.48	0.06	34			34.47
124	36	20,000	136,820	0.06		0.00	0.06	34		0	34.41
124	37	15,900	301,770	0.06		0.00	0.06	34		0	34.41

ORIGINAL DATA FOR VERTICAL TANKS (continued)

Facility #	Tank ID	Tank Capacity	1995 Tank Throughput	Reported HAP Partial Pressure (psia)	HAP Weight Percent	HAP mole fraction	Calculated HAP PP (psia)	Uncontrolled HAP Emissions (lb/yr)	Control Device	Tank Control Device Efficiency	Baseline HAP Emissions (lb/yr)
124	64	13,500	7,800	0.06		0.00	0.06	34		0	34.41
124	65	13,500	89,940	0.06		0.00	0.06	34		0	34.41
125	9	10,472	127,758	0.06		0.00	0.06	34		0	34.41
39	1B105	11,500	146,231		13	0.14	0.06	34			33.77
78	RS-30	10,000	287,500		20	0.20	0.06	33			32.86
84	L-30	20,000	138,000		52	0.51	0.06	32			32.25
43	PP-RS41-1309	12,000	621,675		51	0.50	0.06	32			31.61
78	DS-3	12,000	2,125,500		50	0.49	0.05	31			30.97
84	L-31	20,000	160,000		50	0.49	0.05	31			30.97
43	PP-RS32-1322	12,000	636,501		15	0.15	0.05	31			30.57
43	PP-RS44-1315	12,000	545,733		15	0.15	0.05	31			30.57
39	1B103	11,500	192,718		45	0.44	0.05	28			27.79
40	TK16	20,000	86,400		45	0.44	0.05	28	Carbon Absorption	90	2.78
40	TK17	20,000	86,400		45	0.44	0.05	28	Carbon Absorption	90	2.78
102	315	12,000	71,523		45	0.44	0.05	28			27.79
102	316	12,000	71,523		45	0.44	0.05	28			27.79
39	9B008	24,400	19,411		10	0.11	0.05	26			26.05
98	AST 15	20,000	139,616		10	0.11	0.05	26			26.05
76	H 0208	20,975	25,260		39	0.38	0.04	24			24.00
43	PP-RS43-1310	12,000	229,621		37	0.36	0.04	23			22.74
85	20	20,000	29,439		18.8	0.18	0.04	21			20.99
69	203	11,872	133,200		30	0.29	0.04	21			20.55
106	17	25,912	300,000	0	17	0.17	0.04	20			20.12
44	T001	11,000	95,410		36	0.35	0.03	19			19.04
44	T002	11,000	95,409		36	0.35	0.03	19			19.04

ORIGINAL DATA FOR VERTICAL TANKS (continued)

Facility #	Tank ID	Tank Capacity	1995 Tank Throughput	Reported HAP Partial Pressure (psia)	HAP Weight Percent	HAP mole fraction	Calculated HAP PP (psia)	Uncontrolled HAP Emissions (lb/yr)	Control Device	Tank Control Device Efficiency	Baseline HAP Emissions (lb/yr)
98	AST 18	20,000	128,895		17	0.16	0.03	19			18.96
44	T004	15,228	310,645		35	0.34	0.03	19			18.51
44	T007	14,000	264,303		35	0.34	0.03	19			18.51
44	T015	11,000	204,250		35	0.34	0.03	19			18.51
39	1B110	11,500	286,147		30	0.29	0.03	18			18.37
78	RS-24	10,000	305,100		30	0.29	0.03	18			18.37
43	PP-RS45-1311	12,000	498,036		7	0.08	0.03	18			18.28
40	TK22	12,000	78,950		8	0.08	0.03	17			16.89
88	7R003	11,500	7,352		15	0.14	0.03	17			16.71
43	PP-RS50-1305	12,000	1,344,579		10	0.10	0.03	16			16.43
69	201	11,872	38,600		20	0.19	0.02	14			13.65
43	PP-RS52-1306	12,000	358,450		8	0.08	0.02	13			13.14
84	R-34	10,000	42,498		21	0.20	0.02	13			12.79
78	SWT-2	10,000	13,200		20	0.19	0.02	12			12.17
78	SR-4	10,000	357,300		19	0.18	0.02	12			11.56
125	17	11,821	87,595	0.02		0.00	0.02	11		0	11.47
86	TK 82	16,000	86,333		91	0.90	0.02	10			10.02
67	S6	25,000	136,100		20	0.18	0.02	10			9.68
42	32-T-104	10,000	729,335	0.0168	42	0.01	0.02	10	Thermal incinerator	80.3	1.90
42	32-T-105	10,000	729,335	0.0168	42	0.01	0.02	10	Thermal incinerator	80.3	1.90
42	32-T-110	10,000	729,335	0.0168	42	0.01	0.02	10	Thermal incinerator	80.3	1.90
42	32-T-111	10,000	729,335	0.0168	42	0.01	0.02	10	Thermal incinerator	80.3	1.90
42	32-T-112	10,000	729,335	0.0168	42	0.01	0.02	10	Thermal incinerator	80.3	1.90
78	RS-45	10,000	267,000		15	0.14	0.02	9			9.10
39	1B101	11,500	19,108		6	0.06	0.01	8			8.41

ORIGINAL DATA FOR VERTICAL TANKS (continued)

Facility #	Tank ID	Tank Capacity	1995 Tank Throughput	Reported HAP Partial Pressure (psia)	HAP Weight Percent	HAP mole fraction	Calculated HAP PP (psia)	Uncontrolled HAP Emissions (lb/yr)	Control Device	Tank Control Device Efficiency	Baseline HAP Emissions (lb/yr)
76	H 0206	15,000	121,859		12	0.11	0.01	7			7.27
69	246	10,000	141,900		11.5	0.10	0.01	6			6.47
106	24	14,689	600,000	0	11	0.10	0.01	6			6.42
29	5	12,000	77,160		10	0.09	0.01	6	Carbon tray	30	4.24
43	PP-RS42-1314	12,000	564,480		10	0.09	0.01	6			6.05
78	RS-34	10,000	617,700		10	0.09	0.01	6			6.05
78	RS-46	10,000	427,200		10	0.09	0.01	6			6.05
78	RS-6	10,000	56,200		10	0.09	0.01	6			6.05
79	T01	11,000	92,421		9.8	0.09	0.01	6			5.91
43	PP-RS13-1334	12,000	1,429,327		9	0.09	0.01	5			5.44
86	TK 80	16,000	155,063		52	0.50	0.01	5			5.13
86	TK 92	16,000	155,063		52	0.50	0.01	5			5.13
39	9B114	12,000	115,481		100	1.00	0.01	5			4.88
84	S-2	12,000	42,468		100	1.00	0.01	5			4.88
78	RS-42	10,000	20,500		8	0.08	0.01	5			4.83
86	TK 89	16,000	450,672		10	0.09	0.01	5			4.81
78	RS-36	10,000	411,800		7	0.07	0.01	4			4.23
86	TK 86	16,000	67,744		7	0.07	0.01	4			4.23
39	9B105	12,000	78,429		6	0.05	0.01	4			3.63
40	TK86	14,000	32,150		6	0.05	0.01	4			3.63
41	78	13,920	74,500		6	0.06	0.01	4			3.62
43	PP-RS34-1323	12,000	66,417		6	0.06	0.01	4			3.62
86	TK 203	12,000	507,417		100	1.00	0.00	2			2.41
39	9B115	12,000	18,621		1	0.01	0.00	2			1.64
39	1B107	11,500	42,745		6	0.05	0.00	1			1.26

ORIGINAL DATA FOR VERTICAL TANKS (continued)

Facility #	Tank ID	Tank Capacity	1995 Tank Throughput	Reported HAP Partial Pressure (psia)	HAP Weight Percent	HAP mole fraction	Calculated HAP PP (psia)	Uncontrolled HAP Emissions (lb/yr)	Control Device	Tank Control Device Efficiency	Baseline HAP Emissions (lb/yr)
39	1B115	11,700	130,443		14	0.21	0.00	0			0.14
39	9B002	24,400	304,316		10	0.08	0.00	0			0.14
86	TK 90	16,000	64,626		10	0.08	0.00	0			0.14
102	302	23,000	108,425		10	0.08	0.00	0			0.14
106	5	25,594	200,000	0	4	0.03	0.00	0			0.05
119	TNK-00111	20,000	1,458		3.5	0.03	0.00	0		0	0.05
107	106	11,000	99,300	0.0000015	0	0.00	0.00	0			0.00
29	13	12,000	60,846		100	0.00	0.00	0	Carbon tray	30	0.00
29	35	20,000	410,522		100	0.00	0.00	0	Carbon tray	30	0.00
39	14B0164	21,800	62,725		12	0.00	0.00	0			0.00
39	9B109	12,000	66,499		100	0.00	0.00	0			0.00
39	9B110	12,000	53,887		100	0.00	0.00	0			0.00
40	ST-103	20,000	127,500		18	0.00	0.00	0			0.00
40	ST-104	20,000	183,900		7	0.00	0.00	0			0.00
40	TK117	15,000	183,900		7	0.00	0.00	0	Carbon Absorption	90	0.00
41	6	20,000	27,500		100	0.00	0.00	0			0.00
42	38-T-309	17,000	523,558		100	0.00	0.00	0			0.00
43	PP-RS25-1327	12,000	1,574,221		16	0.00	0.00	0			0.00
43	PP-RS35-1319	12,000	415,194		22	0.00	0.00	0			0.00
64	T-14	20,000	150,400		100	0.00	0.00	0			0.00
64	T-15	20,000	108,000		100	0.00	0.00	0			0.00
67	S8	12,000	252,000		100	0.00	0.00	0			0.00
69	234	10,000	24,800		100	0.00	0.00	0			0.00
71	T6001A/B	12,000	163,800	0	19	0.00	0.00	0			0.00
78	RS-37	10,000	88,400		8	0.00	0.00	0			0.00

ORIGINAL DATA FOR VERTICAL TANKS (continued)

Facility #	Tank ID	Tank Capacity	1995 Tank Throughput	Reported HAP Partial Pressure (psia)	HAP Weight Percent	HAP mole fraction	Calculated HAP PP (psia)	Uncontrolled HAP Emissions (lb/yr)	Control Device	Tank Control Device Efficiency	Baseline HAP Emissions (lb/yr)
78	RS-38	10,000	11,000		6	0.00	0.00	0			0.00
78	RS-40	10,000	112,300		7	0.00	0.00	0			0.00
78	SWT-1	10,000	13,200		70	0.00	0.00	0			0.00
84	R-23	20,000	210,467		14.4	0.00	0.00	0			0.00
86	TK 79	16,000	119,787		100	0.00	0.00	0			0.00
119	TNK-00108	20,000	3,942		100	0.00	0.00	0		0	0.00
							TOTALS	85,161			83,725

Attachment 3
Estimated HAP Emissions and Emission Reductions for Storage Tanks that Meet the Applicability Cutoffs for the Regulatory Alternatives

ESTIMATED UNCONTROLLED EMISSIONS AND EMISSION REDUCTIONS FOR TANKS THAT MEET THE APPLICABILITY CUTOFFS FOR THE REGULATORY ALTERNATIVES

Tank ID	Tank size, gallons	HAP partial pressure[a], psia	Average liquid surface temperature,[b] F	Range of uncontrolled emissions, lb/yr	HAP emission reductions, lb/yr	
					Option 1	Option 2
VERTICAL TANKS						
F51#15	11,000	6.25	64	1,551–3,416		1,396–3,074
F26T#8	20,000	5.71	61	2,184–4,425	1,966–3,983	1,966–3,983
F34T#13	20,000	2.77	75	1,216–2,245	1,094–2,021	1,094–2,021
F25T#22	15,000	2.37	76	215–483		194–435
F99TB(S)ST-12	20,000	2.03	71	816–1,224	734–1,102	734–1,102
F98TAST22	20,000	2.03	71	620–985	558–887	558–887
F32TT002	15,000	2.02	62	382–800		344–720
F34T#7	20,000	1.94	61	700–1,254	630–1,129	630–1,129
F34T#14	20,000	1.94	61	665–1,214	599–1,093	599–1,093
F107T101	11,000	1.93	60	358–697		332–627
F4TT001	12,000	1.81	64			
F85T12	11,700	1.79	67			
F51T16	12,000	1.59	63			
F42T39-T-313	17,000	1.54	62			
F124T#9	20,000	1.47	75			
F106T6	15,547	1.44	60			
F125T#1	10,528	1.01	62			
HORIZONTAL TANKS						
F72TTank#21	12,000	6.44	66	2,496-5,571		2,246-5,014
F112THS-3147	15,000	2.74	79	2,138-4,751		1,762-2,473
F4TT033	12,000	2.09	64	1,958-2,748		1,924-4,276
F77T6100-1	12,500	1.98	91	3,127-3,192		2,814-2,873
F112THS-3103	15,000	1.51	62			
F59T10	12,000	1.48	61			
				Total Emissions Reductions	5,581-10,215	16,583-29,705

[a] HAP partial pressure from TANKS program at average liquid surface temperature, under default conditions.
[b] Average liquid surface temperature is for the hottest month under default conditions.

TANKS 4.0
Emissions Report - Detail Format
Liquid Contents of Storage Tank

Mixture/Component	Month	Daily Liquid Surf. Temperatures (deg F) Avg.	Min.	Max.	Liquid Bulk Temp. (deg F)	Vapor Pressures (psia) Avg.	Min.	Max.	Vapor Mol. Weight	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Methylene chloride	Jan	37.77	34.80	40.75	47.70	3.2521	3.0093	3.5111	84.9400			84.94	Option 2: A=7.409, B=1325.9, C=252.6
Methylene chloride	Feb	38.49	35.05	41.94	47.70	3.3136	3.0293	3.6197	84.9400			84.94	Option 2: A=7.409, B=1325.9, C=252.6
Methylene chloride	Mar	43.03	38.90	47.16	47.70	3.7215	3.3488	4.1280	84.9400			84.94	Option 2: A=7.409, B=1325.9, C=252.6
Methylene chloride	Apr	48.53	43.58	53.49	47.70	4.2713	3.7735	4.8224	84.9400			84.94	Option 2: A=7.409, B=1325.9, C=252.6
Methylene chloride	May	53.94	48.42	59.46	47.70	4.8752	4.2595	5.5628	84.9400			84.94	Option 2: A=7.409, B=1325.9, C=252.6
Methylene chloride	Jun	58.31	52.62	64.01	47.70	5.4142	4.7217	6.1883	84.9400			84.94	Option 2: A=7.409, B=1325.9, C=252.6
Methylene chloride	Jul	60.53	54.97	66.10	47.70	5.7060	4.9982	6.4944	84.9400			84.94	Option 2: A=7.409, B=1325.9, C=252.6
Methylene chloride	Aug	59.28	54.12	64.43	47.70	5.5392	4.8964	6.2500	84.9400			84.94	Option 2: A=7.409, B=1325.9, C=252.6
Methylene chloride	Sep	55.61	50.93	60.29	47.70	5.0758	4.5312	5.6735	84.9400			84.94	Option 2: A=7.409, B=1325.9, C=252.6
Methylene chloride	Oct	50.30	46.30	54.30	47.70	4.4612	4.0400	4.9181	84.9400			84.94	Option 2: A=7.409, B=1325.9, C=252.6
Methylene chloride	Nov	45.20	42.23	48.17	47.70	3.9306	3.6466	4.2326	84.9400			84.94	Option 2: A=7.409, B=1325.9, C=252.6
Methylene chloride	Dec	40.06	37.35	42.77	47.70	3.4497	3.2164	3.6970	84.9400			84.94	Option 2: A=7.409, B=1325.9, C=252.6

TANKS 4.0
Emissions Report - Detail Format
Detail Calculations (AP-42)

Month:	January	February	March	April	May	June	July	August	September	October	November	December
Standing Losses (lb):	61.1809	66.0684	100.7504	138.3855	187.8865	215.2973	233.3869	207.1293	161.2604	120.4070	72.9586	59.0286
Vapor Space Volume (cu ft):	1,441.3283	1,441.3283	1,441.3283	1,441.3283	1,441.3283	1,441.3283	1,441.3283	1,441.3283	1,441.3283	1,441.3283	1,441.3283	1,441.3283
Vapor Density (lb/cu ft):	0.0517	0.0527	0.0586	0.0665	0.0751	0.0827	0.0868	0.0845	0.0780	0.0692	0.0616	0.0546
Vapor Space Expansion Factor:	0.0637	0.0756	0.1004	0.1369	0.1739	0.2010	0.2086	0.1862	0.1528	0.1140	0.0739	0.0602
Vented Vapor Saturation Factor:	0.4157	0.4111	0.3833	0.3513	0.3218	0.2994	0.2885	0.2946	0.3131	0.3415	0.3705	0.4014
Tank Vapor Space Volume												
Vapor Space Volume (cu ft):	1,441.3283	1,441.3283	1,441.3283	1,441.3283	1,441.3283	1,441.3283	1,441.3283	1,441.3283	1,441.3283	1,441.3283	1,441.3283	1,441.3283
Tank Diameter (ft):	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000
Vapor Space Outage (ft):	8.1563	8.1563	8.1563	8.1563	8.1563	8.1563	8.1563	8.1563	8.1563	8.1563	8.1563	8.1563
Tank Shell Height (ft):	16.0000	16.0000	16.0000	16.0000	16.0000	16.0000	16.0000	16.0000	16.0000	16.0000	16.0000	16.0000
Average Liquid Height (ft):	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000
Roof Outage (ft):	0.1563	0.1563	0.1563	0.1563	0.1563	0.1563	0.1563	0.1563	0.1563	0.1563	0.1563	0.1563
Roof Outage (Cone Roof)												
Roof Outage (ft):	0.1563	0.1563	0.1563	0.1563	0.1563	0.1563	0.1563	0.1563	0.1563	0.1563	0.1563	0.1563
Roof Height (ft):	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Roof Slope (ft/ft):	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625
Shell Radius (ft):	7.5000	7.5000	7.5000	7.5000	7.5000	7.5000	7.5000	7.5000	7.5000	7.5000	7.5000	7.5000
Vapor Density												
Vapor Density (lb/cu ft):	0.0517	0.0527	0.0586	0.0665	0.0751	0.0827	0.0868	0.0845	0.0780	0.0692	0.0616	0.0546
Vapor Molecular Weight (lb/lb-mole):	84.9400	84.9400	84.9400	84.9400	84.9400	84.9400	84.9400	84.9400	84.9400	84.9400	84.9400	84.9400
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	3.2521	3.3136	3.7215	4.2713	4.8752	5.4142	5.7060	5.5392	5.0758	4.4612	3.9306	3.4497
Daily Avg. Liquid Surface Temp. (deg. R):	497.4413	498.1650	502.7023	508.2049	513.6096	517.9835	520.2039	518.9466	515.2823	509.9688	504.8696	499.7284
Daily Average Ambient Temp. (deg. F):	23.6000	24.5000	33.8000	45.2000	56.5500	65.9000	71.0500	69.0000	61.9000	51.0500	40.5000	29.1000
Ideal Gas Constant R (psia cuft / (lb-mol-deg R)):	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731
Liquid Bulk Temperature (deg. R):	507.3692	507.3692	507.3692	507.3692	507.3692	507.3692	507.3692	507.3692	507.3692	507.3692	507.3692	507.3692
Tank Paint Solar Absorptance (Shell):	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700
Tank Paint Solar Absorptance (Roof):	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700	0.1700
Daily Total Solar Insulation Factor (Btu/sqft day):	503.1902	747.1709	1,078.7180	1,441.0403	1,746.8886	1,940.4233	1,906.4754	1,641.8723	1,239.5739	837.9101	497.4794	404.2020
Vapor Space Expansion Factor												
Vapor Space Expansion Factor:	0.0637	0.0756	0.1004	0.1369	0.1739	0.2010	0.2086	0.1862	0.1528	0.1140	0.0739	0.0602
Daily Vapor Temperature Range (deg. R):	11.8992	13.7805	16.5107	19.8194	22.0672	22.7724	22.2508	20.6313	18.7164	16.0125	11.8720	10.8520
Daily Vapor Pressure Range (psia):	0.5018	0.5904	0.7792	1.0490	1.3033	1.4666	1.4963	1.3536	1.1423	0.8781	0.5860	0.4806
Breather Vent Press. Setting Range(psia):	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	3.2521	3.3136	3.7215	4.2713	4.8752	5.4142	5.7060	5.5392	5.0758	4.4612	3.9306	3.4497
Vapor Pressure at Daily Minimum Liquid Surface Temperature (psia):	3.0093	3.0293	3.3488	3.7735	4.2595	4.7217	4.9982	4.8964	4.5312	4.0400	3.6466	3.2164
Vapor Pressure at Daily Maximum Liquid Surface Temperature (psia):	3.5111	3.6197	4.1280	4.8224	5.5628	6.1883	6.4944	6.2500	5.6735	4.9181	4.2326	3.6970
Daily Avg. Liquid Surface Temp. (deg R):	497.4413	498.1650	502.7023	508.2049	513.6096	517.9835	520.2039	518.9466	515.2823	509.9688	504.8696	499.7284
Daily Min. Liquid Surface Temp. (deg R):	494.4665	494.7199	498.5746	503.2500	508.0928	512.2904	514.6412	513.7887	510.6032	505.9657	501.9016	497.0154
Daily Max. Liquid Surface Temp. (deg R):	500.4161	501.6101	506.8299	513.1597	519.1264	523.6766	525.7666	524.1044	519.9614	513.9720	507.8376	502.4414
Daily Ambient Temp. Range (deg. R):	13.2000	14.2000	15.8000	18.0000	19.1000	18.8000	18.3000	17.8000	17.8000	16.7000	13.2000	12.4000
Vented Vapor Saturation Factor												
Vented Vapor Saturation Factor:	0.4157	0.4111	0.3833	0.3513	0.3218	0.2994	0.2885	0.2946	0.3131	0.3415	0.3705	0.4014
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	3.2521	3.3136	3.7215	4.2713	4.8752	5.4142	5.7060	5.5392	5.0758	4.4612	3.9306	3.4497
Vapor Space Outage (ft):	8.1563	8.1563	8.1563	8.1563	8.1563	8.1563	8.1563	8.1563	8.1563	8.1563	8.1563	8.1563

TANKS 4.0
Emissions Report - Detail Format
Detail Calculations (AP-42)- (Continued)

Working Losses (lb):	34.3650	35.0146	39.3250	45.1348	51.5164	57.2111	60.2948	58.5322	53.6361	47.1412	41.5344	36.4530
Vapor Molecular Weight (lb/lb-mole):	84.9400	84.9400	84.9400	84.9400	84.9400	84.9400	84.9400	84.9400	84.9400	84.9400	84.9400	84.9400
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	3.2521	3.3136	3.7215	4.2713	4.8752	5.4142	5.7060	5.5392	5.0758	4.4612	3.9306	3.4497
Net Throughput (gal/mo.):	5,225.0000	5,225.0000	5,225.0000	5,225.0000	5,225.0000	5,225.0000	5,225.0000	5,225.0000	5,225.0000	5,225.0000	5,225.0000	5,225.0000
Number of Turnovers:	3.1350	3.1350	3.1350	3.1350	3.1350	3.1350	3.1350	3.1350	3.1350	3.1350	3.1350	3.1350
Turnover Factor:	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Maximum Liquid Volume (cuft):	20,000.0000	20,000.0000	20,000.0000	20,000.0000	20,000.0000	20,000.0000	20,000.0000	20,000.0000	20,000.0000	20,000.0000	20,000.0000	20,000.0000
Maximum Liquid Height (ft):	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000
Tank Diameter (ft):	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000
Working Loss Product Factor:	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total Losses (lb):	95.5459	101.0830	140.0753	183.5203	239.4029	272.5084	293.6817	265.6615	214.8964	167.5482	114.4930	95.4816

TANKS 4.0
Emissions Report - Detail Format
Individual Tank Emission Totals

Emissions Report for: January , February , March , April , May , June , July , August , September , October , November , December

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Methylene chloride	560.16	1,623.74	2,183.90

TANKS 4.0
Emissions Report - Detail Format
Tank Identification and Physical Characteristics

Identification	
User Identification:	F-026 #8
City:	
State:	New York
Company:	
Type of Tank:	Vertical Fixed Roof Tank
Description:	TK008
Tank Dimensions	
Shell Height (ft):	16.00
Diameter (ft):	15.00
Liquid Height (ft):	15.00
Avg. Liquid Height (ft):	8.00
Volume (gallons):	20,000.00
Turnovers:	3.14
Net Throughput (gal/yr):	62,700.00
Is Tank Heated (y/n):	N
Paint Characteristics	
Shell Color/Shade:	Aluminum/Diffuse
Shell Condition:	Good
Roof Color/Shade:	Aluminum/Diffuse
Roof Condition:	Good
Roof Characteristics	
Type:	Cone
Height (ft):	0.00
Slope (ft/ft) (Cone Roof):	0.06
Breather Vent Settings	
Vacuum Settings (psig):	-0.03
Pressure Settings (psig):	0.03

Meteorological Data used in Emissions Calculations: Buffalo, New York (Avg Atmospheric Pressure = 14.37 psia)

TANKS 4.0
Emissions Report - Detail Format
Liquid Contents of Storage Tank

Mixture/Component	Month	Daily Liquid Surf. Temperatures (deg F) Avg.	Min.	Max.	Liquid Bulk Temp. (deg F)	Vapor Pressures (psia) Avg.	Min.	Max.	Vapor Mol. Weight	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Methylene chloride	Jan	40.93	36.44	45.41	50.28	3.5272	3.1412	3.9519	84.9400			84.94	Option 2: A=7.409, B=1325.9, C=252.6
Methylene chloride	Feb	42.48	36.78	48.17	50.28	3.6695	3.1698	4.2331	84.9400			84.94	Option 2: A=7.409, B=1325.9, C=252.6
Methylene chloride	Mar	48.14	40.77	55.52	50.28	4.2299	3.5129	5.0641	84.9400			84.94	Option 2: A=7.409, B=1325.9, C=252.6
Methylene chloride	Apr	54.87	45.58	64.17	50.28	4.9866	3.9685	6.2114	84.9400			84.94	Option 2: A=7.409, B=1325.9, C=252.6
Methylene chloride	May	61.32	50.54	72.09	50.28	5.8122	4.4881	7.4426	84.9400			84.94	Option 2: A=7.409, B=1325.9, C=252.6
Methylene chloride	Jun	66.35	54.82	77.88	50.28	6.5324	4.9795	8.4629	84.9400			84.94	Option 2: A=7.409, B=1325.9, C=252.6
Methylene chloride	Jul	68.46	57.15	79.76	50.28	6.8547	5.2667	8.8164	84.9400			84.94	Option 2: A=7.409, B=1325.9, C=252.6
Methylene chloride	Aug	66.30	56.20	76.40	50.28	6.5247	5.1478	8.1909	84.9400			84.94	Option 2: A=7.409, B=1325.9, C=252.6
Methylene chloride	Sep	61.27	52.86	69.68	50.28	5.8053	4.7490	7.0479	84.9400			84.94	Option 2: A=7.409, B=1325.9, C=252.6
Methylene chloride	Oct	54.59	48.06	61.12	50.28	4.9525	4.2219	5.7845	84.9400			84.94	Option 2: A=7.409, B=1325.9, C=252.6
Methylene chloride	Nov	48.33	43.87	52.80	50.28	4.2502	3.8011	4.7423	84.9400			84.94	Option 2: A=7.409, B=1325.9, C=252.6
Methylene chloride	Dec	42.88	38.95	46.81	50.28	3.7068	3.3525	4.0918	84.9400			84.94	Option 2: A=7.409, B=1325.9, C=252.6

TANKS 4.0
Emissions Report - Detail Format
Detail Calculations (AP-42)

Month:	January	February	March	April	May	June	July	August	September	October	November	December
Standing Losses (lb):	103.7459	125.5792	213.6738	320.4693	472.8753	583.0333	637.0083	524.8914	354.2947	228.0682	123.3743	95.2166
Vapor Space Volume (cu ft):	1,441.3283	1,441.3283	1,441.3283	1,441.3283	1,441.3283	1,441.3283	1,441.3283	1,441.3283	1,441.3283	1,441.3283	1,441.3283	1,441.3283
Vapor Density (lb/cu ft):	0.0558	0.0578	0.0659	0.0767	0.0883	0.0983	0.1027	0.0982	0.0882	0.0762	0.0662	0.0584
Vapor Space Expansion Factor:	0.1051	0.1391	0.2052	0.3049	0.4210	0.5245	0.5500	0.4571	0.3260	0.2103	0.1222	0.0950
Vented Vapor Saturation Factor:	0.3961	0.3867	0.3535	0.3169	0.2847	0.2615	0.2523	0.2617	0.2849	0.3184	0.3525	0.3843
Tank Vapor Space Volume												
Vapor Space Volume (cu ft):	1,441.3283	1,441.3283	1,441.3283	1,441.3283	1,441.3283	1,441.3283	1,441.3283	1,441.3283	1,441.3283	1,441.3283	1,441.3283	1,441.3283
Tank Diameter (ft):	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000
Vapor Space Outage (ft):	8.1563	8.1563	8.1563	8.1563	8.1563	8.1563	8.1563	8.1563	8.1563	8.1563	8.1563	8.1563
Tank Shell Height (ft):	16.0000	16.0000	16.0000	16.0000	16.0000	16.0000	16.0000	16.0000	16.0000	16.0000	16.0000	16.0000
Average Liquid Height (ft):	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000	8.0000
Roof Outage (ft):	0.1563	0.1563	0.1563	0.1563	0.1563	0.1563	0.1563	0.1563	0.1563	0.1563	0.1563	0.1563
Roof Outage (Cone Roof)												
Roof Outage (ft):	0.1563	0.1563	0.1563	0.1563	0.1563	0.1563	0.1563	0.1563	0.1563	0.1563	0.1563	0.1563
Roof Height (ft):	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Roof Slope (ft/ft):	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625	0.0625
Shell Radius (ft):	7.5000	7.5000	7.5000	7.5000	7.5000	7.5000	7.5000	7.5000	7.5000	7.5000	7.5000	7.5000
Vapor Density												
Vapor Density (lb/cu ft):	0.0558	0.0578	0.0659	0.0767	0.0883	0.0983	0.1027	0.0982	0.0882	0.0762	0.0662	0.0584
Vapor Molecular Weight (lb/lb-mole):	84.9400	84.9400	84.9400	84.9400	84.9400	84.9400	84.9400	84.9400	84.9400	84.9400	84.9400	84.9400
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	3.5272	3.6695	4.2299	4.9866	5.8122	6.5324	6.8547	6.5247	5.8053	4.9525	4.2502	3.7068
Daily Avg. Liquid Surface Temp. (deg. R):	500.5955	502.1479	507.8115	514.5449	520.9886	526.0199	528.1250	525.9688	520.9379	514.2600	508.0044	502.5463
Daily Average Ambient Temp. (deg. F):	23.6000	24.5000	33.8000	45.2000	56.5500	65.9000	71.0500	69.0000	61.9000	51.0500	40.5000	29.1000
Ideal Gas Constant R (psia cuft / (lb-mol-deg R)):	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731	10.731
Liquid Bulk Temperature (deg. R):	509.9492	509.9492	509.9492	509.9492	509.9492	509.9492	509.9492	509.9492	509.9492	509.9492	509.9492	509.9492
Tank Paint Solar Absorptance (Shell):	0.6000	0.6000	0.6000	0.6000	0.6000	0.6000	0.6000	0.6000	0.6000	0.6000	0.6000	0.6000
Tank Paint Solar Absorptance (Roof):	0.6000	0.6000	0.6000	0.6000	0.6000	0.6000	0.6000	0.6000	0.6000	0.6000	0.6000	0.6000
Daily Total Solar Insulation Factor (Btu/sqft day):	503.1902	747.1709	1,078.7180	1,441.0403	1,746.8886	1,940.4233	1,906.4754	1,641.8723	1,239.5739	837.9101	497.4794	404.2020
Vapor Space Expansion Factor												
Vapor Space Expansion Factor:	0.1051	0.1391	0.2052	0.3049	0.4210	0.5245	0.5500	0.4571	0.3260	0.2103	0.1222	0.0950
Daily Vapor Temperature Range (deg. R):	17.9576	22.7765	29.4985	37.1695	43.0997	46.1351	45.2048	40.3995	33.6408	26.1009	17.8617	15.7186
Daily Vapor Pressure Range (psia):	0.8107	1.0633	1.5512	2.2429	2.9545	3.4834	3.5497	3.0432	2.2989	1.5626	0.9412	0.7393
Breather Vent Press. Setting Range(psia):	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600	0.0600
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	3.5272	3.6695	4.2299	4.9866	5.8122	6.5324	6.8547	6.5247	5.8053	4.9525	4.2502	3.7068
Vapor Pressure at Daily Minimum Liquid Surface Temperature (psia):	3.1412	3.1698	3.5129	3.9685	4.4881	4.9795	5.2667	5.1478	4.7490	4.2219	3.8011	3.3525
Vapor Pressure at Daily Maximum Liquid Surface Temperature (psia):	3.9519	4.2331	5.0641	6.2114	7.4426	8.4629	8.8164	8.1909	7.0479	5.7845	4.7423	4.0918
Daily Avg. Liquid Surface Temp. (deg R):	500.5955	502.1479	507.8115	514.5449	520.9886	526.0199	528.1250	525.9688	520.9379	514.2600	508.0044	502.5463
Daily Min. Liquid Surface Temp. (deg R):	496.1061	496.4538	500.4368	505.2525	510.2137	514.4862	516.8238	515.8689	512.5277	507.7348	503.5390	498.6166
Daily Max. Liquid Surface Temp. (deg R):	505.0849	507.8420	515.1861	523.8372	531.7635	537.5537	539.4262	536.0687	529.3481	520.7852	512.4698	506.4759
Daily Ambient Temp. Range (deg. R):	13.2000	14.2000	15.8000	18.0000	19.1000	18.8000	18.3000	17.8000	17.8000	16.7000	13.2000	12.4000
Vented Vapor Saturation Factor												
Vented Vapor Saturation Factor:	0.3961	0.3867	0.3535	0.3169	0.2847	0.2615	0.2523	0.2617	0.2849	0.3184	0.3525	0.3843
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	3.5272	3.6695	4.2299	4.9866	5.8122	6.5324	6.8547	6.5247	5.8053	4.9525	4.2502	3.7068
Vapor Space Outage (ft):	8.1563	8.1563	8.1563	8.1563	8.1563	8.1563	8.1563	8.1563	8.1563	8.1563	8.1563	8.1563

TANKS 4.0
Emissions Report - Detail Format
Detail Calculations (AP-42)- (Continued)

Working Losses (lb):	37.2718	38.7758	44.6971	52.6929	61.4168	69.0272	72.4332	68.9461	61.3439	52.3322	44.9113	39.1698
Vapor Molecular Weight (lb/lb-mole):	84.9400	84.9400	84.9400	84.9400	84.9400	84.9400	84.9400	84.9400	84.9400	84.9400	84.9400	84.9400
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	3.5272	3.6695	4.2299	4.9866	5.8122	6.5324	6.8547	6.5247	5.8053	4.9525	4.2502	3.7068
Net Throughput (gal/mo.):	5,225.0000	5,225.0000	5,225.0000	5,225.0000	5,225.0000	5,225.0000	5,225.0000	5,225.0000	5,225.0000	5,225.0000	5,225.0000	5,225.0000
Number of Turnovers:	3.1350	3.1350	3.1350	3.1350	3.1350	3.1350	3.1350	3.1350	3.1350	3.1350	3.1350	3.1350
Turnover Factor:	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Maximum Liquid Volume (cuft):	20,000.0000	20,000.0000	20,000.0000	20,000.0000	20,000.0000	20,000.0000	20,000.0000	20,000.0000	20,000.0000	20,000.0000	20,000.0000	20,000.0000
Maximum Liquid Height (ft):	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000
Tank Diameter (ft):	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000	15.0000
Working Loss Product Factor:	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000
Total Losses (lb):	141.0176	164.3550	258.3709	373.1622	534.2921	652.0605	709.4416	593.8376	415.6386	280.4004	168.2856	134.3864

TANKS 4.0
Emissions Report - Detail Format
Individual Tank Emission Totals

Emissions Report for: January , February , March , April , May , June , July , August , September , October , November , December

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Methylene chloride	643.02	3,782.23	4,425.25

Attachment 4
TANKS 4.0 Default Parameters

TANKS 4.0 DEFAULT PARAMETERS

Parameter	TANKS default
VERTICAL TANKS	
Shell color/shade	white/white
Shell condition	good
Roof color/shade	white/white
Roof type slope (ft/ft)	cone 0.06
Breather vent settings vacuum settings (psig) pressure settings (psig)	 -0.03 0.03
Tank heated	no
Meteorological data	nearest city in TANKS 4.0 data base
HORIZONTAL TANKS	
Shell color/shade	white/white
Shell condition	good
Breather vent settings vacuum settings (psig) pressure settings (psig)	 -0.03 0.03
Tank heated?	no
Tank underground?	no
Meteorological data	nearest city in TANKS 4.0 data base

Attachment 5
IFR Cost Calculation Module

```
Option Compare Database
Option Explicit

Public Sub IFRCost()
 Dim dbs As Database
 Dim rst As Recordset
 Dim TankSize As Double                'tank capacity, gal
 Dim TankDia As Double                 'tank diameter, ft
 Dim Degas As Double                   'cleaning and degassing of tank, $
 Dim FlRoof As Double                  'new floating roof, $
 'Dim SecSeal As Double                'addition of secondary seal, $
 'Dim CtrlDeck As Double               'addition of control deck fittings, $
 Dim CtrlDev As Variant                'control device
 Dim CtrlEff As Variant                'control device efficiency (percent)
 Dim CalcEmiss As Double               'calculated emissions (lb/yr)
 Const Price As Double = 0.1           'price for recovered voc, $/lb
 Dim RemovCond As Double               'removing existing condenser, $
 Dim TAC As Double                     'total annualized cost, $/yr
 Dim CapCost As Double                 'capitalized cost, $
 Dim PEC As Double                     'purchased equipment cost, $
 Dim TCI As Double                     'total capital investment, $
 Dim DAC As Double                     'direct annual cost, $/yr
 Dim EmissRed As Double                'hap reduction (lb/yr)
 Dim OandM As Double                   'operating and maintenance cost, $/yr
 Const MRR As Single = 0               'marketing, reporting and recordkeeping cost, $/yr
 Dim ACR As Double                     'annualized capital cost, $/yr
 Dim RC As Double                      'recovery credit, $/yr
 Dim PP As Double                      'HAP PP, psia
 Dim Capacity As Double                'Tank size, gallons

 Set dbs = CurrentDb
 Set rst = dbs.OpenRecordset("Vertical Tanks w/estimated PP and Control Cost")

 rst.MoveFirst
 Do While Not rst.EOF
    TankSize = rst![Tank Capacity]
    CtrlDev = rst![Control Device]
    CtrlEff = rst![Tank Control Device Efficiency]
    CalcEmiss = rst![Baseline HAP (lb/yr)]
    EmissRed = rst![HAP Reduction (lb/yr)]
    Capacity = rst![Tank Capacity]
    PP = rst![HAP PP (psia)]

    Degas = 7.61 * (TankSize) ^ (0.5132)    'July 1989 dollars, from HON
                                                'analysis

    TankDia = Int((TankSize / 7.481) ^ (1 / 3)) + 1    'assumes cylindrical vol= pi (D^2)h/4
                                                       'and D=(cylindrical vol)^(1/3) and
                                                       '1 cuft = 7.481 gal
    FlRoof = 509 * (TankDia) + 1160         'July 1989 dollars, from HON anaylsis
    'SecSeal = 95.1 * (TankDia)
    'CtrlDeck = 16 * (TankDia) + 46
    RemovCond = 284                         'per tank

'If CtrlDev = "Condenser" And Not IsNull(CtrlEff) Then
'     EmissRed = (0.8 - (CtrlEff / 100)) * (CalcEmiss)
'Else
'    EmissRed = 0.8 * (CalcEmiss)
'End If

If Not IsNull(CtrlDev) Then
    CapCost = (Degas + FlRoof + RemovCond) * (387.9 / 356) 'esclated using CE
```

```
                                                            'indexes from Feb 99
                                                            'and July 89
Else
    CapCost = (Degas + FlRoof) * (387.9 / 356)             'esclated using CE
                                                            'indexes from Feb 99
                                                            'and July 89
End If

    TAC = ((CapCost * 0.2098) - (EmissRed * Price))
    OandM = TAC - (0.1098 * CapCost) + (Price * EmissRed)
    ACR = 0.1098 * CapCost                                 'assumes 15 year life;
                                                              '7% interest rate
    RC = 0.1 * EmissRed


    rst.Edit

    If EmissRed <> 0 And Capacity >= 20000 And PP >= 1.9 Then
        rst![IFR-TCI ($)] = CapCost
        rst![IFR-TAC ($/yr)] = TAC
        rst![O&M ($/yr)] = OandM
        rst![ACR ($/yr)] = ACR
        rst![MRR ($/yr)] = MRR
        rst![RC ($/yr)] = RC
    Else
        rst![IFR-TCI ($)] = 0
        rst![IFR-TAC ($/yr)] = 0
        rst![O&M ($/yr)] = 0
        rst![ACR ($/yr)] = 0
        rst![MRR ($/yr)] = 0
        rst![RC ($/yr)] = 0

    End If
    rst.Update

    rst.MoveNext
 Loop

 End Sub
```

Attachment 6
Condenser Cost Algorithm

TOTAL ANNUAL COST SPREADSHEET PROGRAM--REFRIGERATION/PACKAGE [1]

COST BASE DATE: Third Quarter 1990 [2]

VAPCCI (First Quarter 1999--FINAL): [3]	106.1	
INPUT PARAMETERS:		
-- Throughput, gal/yr	33,300	
-- Assumed fill rate, gal/min	150	
-- Inlet stream flowrate (scfm):	20	
-- Inlet stream temperature (oF):	68	
-- VOC to be condensed:	Methylene chloride	
-- VOC inlet volume fraction:	0.457	Assume saturated at 68
-- Required VOC removal (fraction):	0.900	
-- Antoine equation constants for VOC: [4]		
A:	7.409	
B:	1325.900	
C:	252.600	
-- VOC heat of condensation (BTU/lb-mole):	12091	
-- VOC heat capacity (BTU/lb-mole-oF):	12.200	
-- Coolant specific heat (BTU/lb-oF):	0.650	
-- VOC boiling point (oF):	104	
-- VOC critical temperature (oR):	919	
-- VOC molecular weight (lb/lb-mole):	85	
-- VOC condensate density (lb/gal):	6.60	Not used?
-- Air heat capacity (BTU/lb-mole-oF):	6.95	
DESIGN PARAMETERS:		
-- Outlet VOC partial pressure (mm Hg):	59.0	
-- Condensation temperature, Tc (oF):	0.6	
(oR):	460.6	
Working losses (used to size condenser)		
-- VOC flowrate in (lb-moles/hr):	1.43	
-- VOC flowrate out (lb-moles/hr):	0.143	
-- VOC condensed (lb-moles/hr):	1.285	
(lb/hr):	109.3	For 3.7 hr/yr
Breathing losses (from TANKS program), lb/yr	1,945	
-- VOC heat of condensation @ Tc (BTU/lb-mole):	13,324	
-- Enthalpy change, condensed VOC (BTU/hr):	18,184	
-- Enthalpy change, uncondensed VOC (BTU/hr):	117	
-- Enthalpy change, air (BTU/hr):	769	
-- Condenser heat load (BTU/hr):	19,070	
-- Heat transfer coefficient, U (BTU/hr-ft2-oF):	20	
-- Log-mean temperature difference (oF):	31.6	
-- Condenser surface area (ft2):	30.2	
-- Coolant flowrate (lb/hr):	1174	
-- Refrigeration capacity (tons):	1.59	
-- Electricity requirement (kW/ton):	4.7	
CAPITAL COSTS		
Equipment Costs ($):		
-- Refrigeration unit/single-stage (< 10 tons):	21,565	
-- Refrigeration unit/single-stage (> 10 tons):	0	
-- Multistage refrigeration unit:	0	
-- Auxiliaries (ductwork, etc.):	0	
Total equipment cost ($)--base:	26,957	
' ' ' ' --escalated:	27,494	
Purchased Equipment Cost ($):	29,693	

Total Capital Investment ($): 34,147

ANNUAL COST INPUTS:

Operating factor (hr/yr):	8,760	
Operating labor rate ($/hr):	15.64	
Maintenance labor rate ($/hr):	17.20	
Operating labor factor (hr/sh):	0.00	If ref. cap <7, use 0
Maintenance labor factor (hr/sh):	0.50	
Electricity price ($/kWhr):	0.0590	
Recovered VOC value ($/lb):	0.10	
Annual interest rate (fraction):	0.07	
Control system life (years):	15	
Capital recovery factor:	0.1098	
Taxes, insurance, admin. factor:	0.04	

ANNUAL COSTS:

Item	Cost ($/yr)	Wt. Factor	W.F.(cond.)
Operating labor	0	0.000	----
Supervisory labor	0	0.000	----
Maintenance labor	9,419	0.264	----
Maintenance materials	9,419	0.264	----
Electricity			
--during filling events	2	0.000	----
--all other times (assume 10% of rate while filling)	454	0.013	
Overhead	11,303	0.317	0.844
Taxes, insurance, administrative	1,366	0.038	----
Capital recovery	3,749	0.105	0.143
Total Annual Cost (without credits)	35,713	1.000	0.987
Recovery credits	(235)		
Total Annual Cost (with credits)	35,478		

NOTES:

----

[1] Data used to develop this spreadsheet were taken from Chapter 8 of the OAQPS CONTROL COST MANUAL (5th edition).

[2] Base equipment costs reflect this date.

[3] VAPCCI = Vatavuk Air Pollution Control Cost Index (for refrigeration systems) corresponding to year and quarter shown. Base equipment cost, purchased equipment cost, and total capital investment have been escalated to this date via the VAPCCI and control equipment vendor data.

[4] See MANUAL, Table 8.8, for list of Antoine constants.

Electricity Requirement (kW/ton) vs. Condensation Temp. (oF)

-100	11.7
-50	5.0
-20	4.7
20	2.2
40	1.3

Attachment 7

Cost and Cost Effectiveness for Vertical Storage Tanks

(Internal Floating Roof)

Table 1. Coating Manufacturing Vertical Storage Tanks
Tank Size => 20,000 gal and HAP Partial Pressure => 1.9 psia (Option 1)
Shell and Roof Color/Shade: White/white

	Facility #	Tank ID	Total Capacity (gal)	Estimated HAP Partial Pressure (psia)	Uncontrolled HAP Emissions (lb/yr)	Control Device	Control Efficiency	Baseline HAP Emissions (lb/yr)	HAP Reduction (lb/yr)	TAC ($/yr)	TCI ($)	CE ($/ton)
1	34	# 8	20,000	5.71	2,184			2,184	1,966	$1,978	$10,365	$2,013
2	34	# 13	20,000	2.77	1,216			1,216	1,094	$2,065	$10,365	$3,774
3	99	B(S)ST-12	20,000	2.03	816			816	734	$2,101	$10,365	$5,722
4	98	AST 22	20,000	2.03	620			620	558	$2,119	$10,365	$7,595
5	34	# 7	20,000	1.94	700			700	630	$2,112	$10,365	$6,705
6	34	# 14	20,000	1.94	665			665	599	$2,115	$10,365	$7,068
							Totals	6,201	5,581	$12,490	$62,190	$4,476

Table 2. Coating Manufacturing Vertical Storage Tanks
Tank Size => 20,000 gal and HAP Partial Pressure => 1.9 psia (Option 1)
Shell and Roof Color/Shade: Aluminum/diffuse

	Facility #	Tank ID	Total Capacity (gal)	Estimated HAP Partial Pressure (psia)	Uncontrolled HAP Emissions (lb/yr)	Control Device	Control Efficiency	Baseline HAP Emissions (lb/yr)	HAP Reduction (lb/yr)	TAC ($/yr)	TCI ($)	CE ($/ton)
1	34	# 8	20,000	5.71	4,425			4,425	3,983	$1,776	$10,365	$892
2	34	# 13	20,000	2.77	2,245			2,245	2,021	$1,973	$10,365	$1,953
3	99	B(S)ST-12	20,000	2.03	1,224			1,224	1,102	$2,064	$10,365	$3,747
4	98	AST 22	20,000	2.03	985			985	887	$2,086	$10,365	$4,706
5	34	# 7	20,000	1.94	1,254			1,254	1,129	$2,062	$10,365	$3,654
6	34	# 14	20,000	1.94	1,214			1,214	1,093	$2,065	$10,365	$3,780
							Totals	11,347	10,212	$12,026	$62,190	$2,355

Table 3. Coating Manufacturing Vertical Storage Tanks
Tank Size => 10,000 gal and HAP Partial Pressure => 1.9 psia (Option 2)
Shell and Roof Color/Shade: White/white

	Facility #	Tank ID	Total Capacity (gal)	Estimated HAP Partial Pressure (psia)	Uncontrolled HAP Emissions (lb/yr)	Control Device	Control Efficiency	Baseline HAP Emissions (lb/yr)	HAP Reduction (lb/yr)	TAC ($/yr)	TCI ($)	CE ($/ton)
1	51	15	11,000	6.25	1,551			1,551	1,396	$1,728	$8,903	$2,476
2	34	# 8	20,000	5.71	2,184			2,184	1,966	$1,978	$10,365	$2,013
3	34	# 13	20,000	2.77	1,216			1,216	1,094	$2,065	$10,365	$3,774
4	25	#22	15,000	2.37	215			215	194	$2,000	$9,627	$20,672
5	99	B(S)ST-12	20,000	2.03	816			816	734	$2,101	$10,365	$5,722
6	98	AST 22	20,000	2.03	620			620	558	$2,119	$10,365	$7,595
7	32	T002	15,000	2.02	382			382	344	$1,985	$9,627	$11,547
8	34	# 7	20,000	1.94	700			700	630	$2,112	$10,365	$6,705
9	34	# 14	20,000	1.94	665			665	599	$2,115	$10,365	$7,068
10	107	101	11,000	1.94	358			358	322	$1,836	$8,903	$11,397
							Totals	8,707	7,836	$20,039	$99,250	$5,114

Table 4. Coating Manufacturing Vertical Storage Tanks
Tank Size => 10,000 gal and HAP Partial Pressure => 1.9 psia (Option 2)
Shell and Roof Color/Shade: Aluminum/diffuse

	Facility #	Tank ID	Total Capacity (gal)	Estimated HAP Partial Pressure (psia)	Uncontrolled HAP Emissions (lb/yr)	Control Device	Control Efficiency	Baseline HAP Emissions (lb/yr)	HAP Reduction (lb/yr)	TAC ($/yr)	TCI ($)	CE ($/ton)
1	51	15	11,000	6.25	3,416			3,416	3,074	$1,560	$8,903	$1,015
2	34	# 8	20,000	5.71	4,425			4,425	3,983	$1,776	$10,365	$892
3	34	# 13	20,000	2.77	2,245			2,245	2,021	$1,973	$10,365	$1,953
4	25	#22	15,000	2.37	483			483	435	$1,976	$9,627	$9,091
5	99	B(S)ST-12	20,000	2.03	1,224			1,224	1,102	$2,064	$10,365	$3,747
6	98	AST 22	20,000	2.03	985			985	887	$2,086	$10,365	$4,706
7	32	T002	15,000	2.02	800			800	720	$1,948	$9,627	$5,411
8	34	# 7	20,000	1.94	1,254			1,254	1,129	$2,062	$10,365	$3,654
9	34	# 14	20,000	1.94	1,214			1,214	1,093	$2,065	$10,365	$3,780
10	107	101	11,000	1.94	697			697	627	$1,805	$8,903	$5,755
							Totals	16,743	15,069	$19,315	$99,250	$2,564

Attachment 8
Cost and Cost Effectiveness for Horizontal Storage Tanks
(Condenser)

Table 1. Coating Manufacturing Horizontal Storage Tanks
Tank Size => 10,000 gal and HAP Partial Pressure => 1.9 psia (Option 2)
Shell and Roof Color/Shade: White/white

	Facility #	Tank ID	Total Capacity (gal)	Estimated HAP Partial Pressure (psia)	Uncontrolled HAP Emissions (lb/yr)	Control Device	Control Efficiency	Baseline HAP Emissions (lb/yr)	HAP Reduction (lb/yr)	TAC ($/yr)	TCI ($)	CE ($/ton)
1	72	Tank #21	12,000	6.44	2,496			2,496	2,246	$35,478	$34,147	$31,587
2	112	HS-3147	15,000	2.74	2,138		0.00	2,138	1,924	$35,478	$34,147	$36,876
3	4	T033	12,000	2.10	1,958			1,958	1,762	$35,478	$34,147	$40,266
4	77	T-6100-1	12,500	1.98	3,127			3,127	2,814	$35,478	$34,147	$25,213
							Totals	9,719	8,747	$141,912	$136,588	$32,448

Table 2. Coating Manufacturing Horizontal Storage Tanks
Tank Size => 10,000 gal and HAP Partial Pressure => 1.9 psia (Option 2)
Shell and Roof Color/Shade: White/white

	Facility #	Tank ID	Total Capacity (gal)	Estimated HAP Partial Pressure (psia)	Uncontrolled HAP Emissions (lb/yr)	Control Device	Control Efficiency	Baseline HAP Emissions (lb/yr)	HAP Reduction (lb/yr)	TAC ($/yr)	TCI ($)	CE ($/ton)
1	72	Tank #21	12,000	6.44	5,571			5,571	5,014	$35,478	$34,147	$14,152
2	112	HS-3147	15,000	2.74	4,751		0.00	4,751	4,276	$35,478	$34,147	$16,594
3	4	T033	12,000	2.10	2,748			2,748	2,473	$35,478	$34,147	$28,690
4	77	T-6100-1	12,500	1.98	3,192			3,192	2,873	$35,478	$34,147	$24,699
							Totals	16,262	14,636	$141,912	$136,588	$19,392

INTEROFFICE MEMORANDUM

MIDWEST RESEARCH INSTITUTE

March 1, 2000

To: MON Project File

From: Brenda Shine, North State Engineering
David Randall, MRI

Subject: MACT Regulatory Alternatives and Impacts for Wastewater at Surface Coating Facilities
Miscellaneous Organic NESHAP
EPA Project No. 99-607; MRI Project No. 104803.1.049

I. Introduction

This memorandum revises information presented in earlier memoranda regarding the determination of the MACT floor regulatory alternatives for MON coatings manufacturing wastewater.[1,2] The earlier memoranda established the criteria for control of wastewater streams based on a minimum wastewater flow rate and HAP concentration. This memorandum explores the possibility of establishing control requirements based on HAP concentration only. As a result of this analysis, it is recommended that the existing and new source MACT floors be based on HAP concentration only.

II. MACT Floors and Regulatory Alternatives

In the previous analyses, the existing source MACT floor for wastewater was determined to be control of all wastewater streams generated in volumes of greater than 22,000 gallons per year and having a HAP concentration of 4,000 ppmw HAP. Further, the new source MACT floor was determined to be control of wastewater streams generated in volumes of greater than 880 gal/yr and having a HAP concentration of 1,600 ppmw. These requirements are based on the practices of 9 facilities that reported information regarding wastewater on 10 streams. Five of the ten wastewater streams were reported as being controlled, and all were controlled by being drummed and incinerated by virtue of the fact that they were also RCRA wastes. Thus, the control level was considered to be equivalent to that required by the HON. The data for all 10 streams are presented in Attachment 1.

In selecting MACT for wastewater, the previous analyses assumed that the total quantity of generated wastewater, in addition to HAP concentration, would determine treatment options. This assumption is also made in other MACT rules, such as the HON. The use of both flowrate and concentration to identify streams for control is based on the assumption that the cost and effectiveness of controls depend on both the concentration of HAPs in the wastewater and the quantity of wastewater generated. This is a reasonable assumption for facilities that treat wastes on site, such as facilities that steam strip wastewater onsite. However, for small quantity generators such as the surface coating manufacturing facilities that are controlling their wastewater, the need for treatment is driven by the characteristics of the wastewater, not the flow rate. These facilities are able to drum the wastewater and send offsite for treatment. Alternatively, they may be able to discharge the wastewater to a POTW, especially, if the wastewater contains compounds with low Fr values. As a result, the cost effectiveness of the treatment also is affected only by the characteristics of the wastewater (e.g., the HAP concentration), not the flow rate.

Because the total quantity of wastewater generated is not significant to the overall cost effectiveness of treatment, the project team proposes to set the MACT floor for this industry segment based only on HAP concentration, and not flowrate. Based on the data from the industry, the MACT floor for existing sources would be set based on a concentration of 4,000 ppmw, representing the median concentration of controlled streams from the industry, while the MACT floor for new sources would be set based on a concentration of 2,000 ppmw, which corresponds to the lowest HAP concentration that is controlled--1,600 ppmw, rounded up. For existing sources, a regulatory alternative was developed based on the 2,000 ppmw concentration cutoff. No regulatory alternatives were developed for new sources because the floor represents a stringent level of control beyond which the cost clearly would not be reasonable. The required treatment and control levels for the both MACT floors and the regulatory alternative for existing sources are still the same levels as in the HON. Table 1 summarizes the regulatory alternatives.

TABLE 1. MACT FLOOR AND REGULATORY ALTERNATIVES
FOR EXISTING AND NEW FACILITIES

Type of source	Regulatory alternative	Control requirement	Applicability cutoffs (HAP concentration, ppmw)
Existing	MACT floor	Treatment and control options as in the HON	4,000
	Regulatory alternative 1	Treatment and control options as in the HON	2,000
New	MACT Floor	Treatment and control options as in the HON	2,000

III. Impacts Analysis

The costs, emission reductions, and cost effectiveness of the MACT floor and regulatory alternative for existing sources are summarized in Table 2. The procedures used to develop these impacts are described in this section.

TABLE 2. IMPACTS OF REGULATORY ALTERNATIVES FOR EXISTING SOURCES

Regulatory alternative	Number of affected streams	Total capital investment, $	Total annual cost $/yr	Emission reduction, Mg/yr[a]	Cost effectiveness, $/Mg	
					Relative to baseline	Incremental
MACT floor	4	722,000	307,000	10.7	28,700	N/A
Regulatory alternative	8	1,081,000	396,000	11.1	35,700	223,000

[a] Nationwide uncontrolled and baseline emissions are estimated to be 14.2 Mg/yr and 13.5 Mg/yr, respectively.

A. Emissions Estimates

Uncontrolled emissions from each stream were estimated from the HAP loads and the Fe values for each HAP using the following equation:

(Eq. 1)

$$Uncontrolled\ HAP\ emissions,\ lb/yr = \sum_{i=1}^{n} (HAP_i\ load, lb/yr \times Fe_i)$$

The Fe values for each HAP are from Table 34 in subpart H of the HON. The table in the HON contains information on three glycol ethers. Because we do not know the specific glycol ethers in the wastewater streams from the coatings facilities, we used the average of the Fe values for these three glycol ethers.

The HAP loads for each wastewater stream were calculated from the reported flow rates and HAP concentrations as follows:

(Eq. 2)

Baseline emissions for the five streams that are not treated were assumed to be equal to the uncontrolled emissions. Baseline emissions from the five streams that are transferred offsite for treatment in a RCRA incinerator were assumed to be equal to 5 percent of the load. (This is a conservative estimate because one would expect a RCRA incinerator to achieve better destruction levels.)

Emission reductions achieved under the MACT floor and regulatory alternative were estimated assuming the amount of HAP removed by the treatment method is equivalent to the Fr value (from Table 9 in subpart H of the HON) as follows:

(Eq. 3)

$$HAP\ reduction, lb/yr = baseline\ emissions, lb/yr - \sum_{i=1}^{n} \left((HAP\ load)_i (1 - Fr_i)(Fe_i) \right)$$

Wastewater stream characteristics and the estimated uncontrolled and baseline emissions for each wastewater stream are presented in Attachment 1. Emission reductions are also presented in Attachment 1 for the streams that meet the applicability cutoffs.

B. Cost Impacts

Treatment costs for all streams that would require additional control under the MACT floor or regulatory alternative were estimated for a steam stripper. Two assumptions in the analysis are that (1) the necessary steam would be available without the need to install and operate a boiler and (2) operators already on staff have the skills to operate the steam stripper. In addition, because the volume of the wastewater streams is so low, the steam strippers have very low utilization rates (the utilization rate is also affected by our assumption that the steam strippers would be designed for a wastewater feed rate of at least 5 gal/min). As a result, the standard operator and maintenance labor estimates of 0.5 hour per 8 hours of operation are likely to be too low because they neglect the effort associated with startup and shutdown. To approximate this additional effort, we assumed labor estimates of 4 hours per 8 hours of operation. Another consequence of the low wastewater feed rates is that the equations used to estimate costs for some components in the system have been extrapolated beyond the lower end of their recommended ranges; this approach may underestimate the capital costs for those components.

Costs for drumming and treatment at an offsite facility were also estimated for the smallest of the wastewater streams that would require additional control (i.e., stream EPXCWLL201, which contains 13,500 gal/yr). At a disposal cost of $400/drum, the total annual cost of offsite treatment is $98,200/yr. Although this cost is higher than the estimated cost of steam stripping, we have used it to estimate the impacts of the MACT floor and the regulatory alternative for two reasons. First, the uncertainties in the steam stripper cost analysis are magnified for small streams. Second, from a practical standpoint, a facility is unlikely to install, maintain, and monitor a steam stripper for such a small wastewater stream.

The steam stripping costs for the streams at plants 43, 67, and 124 may also be underestimated. However, it is likely that these plants would elect to comply with a biological treatment option (because the wastewater from these facilities contains only glycol ethers, which would readily biodegrade by the required mass removal fraction efficiency). We did not estimate the cost of biotreatment, but it is likely that the cost of this option, especially treatment at an existing offsite facility such as a POTW, would be significantly lower than the estimated steam stripping costs.

The estimated costs for each wastewater stream subject to additional control under the MACT floor and regulatory alternatives are presented in Attachment 1. Copies of the algorithms used to estimate the costs are presented in Attachment 2.

IV. References

1. Memorandum from C. Zukor and R. Howle, Alpha-Gamma Technologies, Inc., to Miscellaneous Organic NESHAP Project File. June 22, 1999.

2. Memorandum from C. Zukor and R. Howle, Alpha-Gamma Technologies, Inc., to Miscellaneous Organic NESHAP Project File. June 7, 1999. New Source MACT Floors for Surface Coating Manufacturing Processes.

3. Memorandum from C. Zukor and K. Pelt, Radian Corporation, to Mary Tom Kissell, EPA:SDB. February 1, 1994. Total Capital Investment and Total Annual Cost Equations Used in the Framework for Steam Stripping Wastewater.

Attachment 1

Emissions Estimates and Regulatory Impacts

ESTIMATED EMISSIONS FROM WASTEWATER STREAMS AT COATINGS FACILITIES

Facility No.	Waste water ID	Quantity of wastewater, gal/yr	HAP	HAP conc., ppmw	HAP load, lb/yr	Fr (a)	Fe (a)	Uncontrolled HAP emissions, lb/yr	Baseline HAP emissions, lb/yr	
41	EPXCWLL201	13,500	ethylbenzene	50,000	5,623	0.99	0.808	16,087	16,087	
			MIBK	50,000	5,623	0.99	0.447			
			toluene	50,000	5,623	0.99	0.778			
			xylenes	50,000	5,623	0.99	0.799			
			glycol ethers	10,000	1,125	0.65	0.145			
43	Tank 1909	357,000	glycol ethers	3,000	8,921	0.65	0.145	1,294	1,294	
65	WW1	22,000	toluene	1,000	183	0.99	0.778	366	37	(b)
			xylenes	1,000	183	0.99	0.799			
			MEK	1,000	183	0.958	0.32			
			MeOH	1,000	183	0.317	0.098			
67	WW1	500,000	glycol ethers	10,000	41,650	0.65	0.145	6,039	6,039	
73	CWW	11,000	MEK	1,200	110	0.958	0.32	35	35	
94	WW01	7,000	glycol ethers	40,000	2,332	0.65	0.145	338	117	(b)
94	WW02	880	glycol ethers	1,600	12	0.65	0.145	1.70	0.59	(b)
101	LF	4,300	MEK	100,000	3,582	0.958	0.32	1,146	179	(b)
119	WBP	18,971	MEK	1,000	158	0.958	0.32	73	16	(b)
			glycol ethers	1,000	158	0.65	0.145			
124	Latex	500,000	glycol ethers	10,000	41,650	0.65	0.145	6,039	6,039	
						Totals:		31,419	29,843	

(a) The Fr and Fe values are from Tables 9 and 34 in subpart G of the HON. The values for glycol ethers are the average for the 3 glycol ethers in the tables.

(b) Assumes the offsite incinerator control destroys 95 percent of each HAP, and the rest is emitted.

MACT FLOOR COST IMPACTS

Facility No.	Waste water ID	HAP emission reduction, lb/yr	Steam stripper		Offsite disposal		To meet the floor		
			TCI, $	TAC, $/yr	TCI, $/yr	TAC, $/yr	TCI, $	TAC, $/yr	Cost effectiveness, $/Mg
41	EPXCWLL201	15,870	286,000	45,600	0	98,200	0	98,200	13,600
65	WW1	0	0	0	0	0	0	0	
67	WW1	3,926	361,000	104,200	N/A	N/A	361,000	104,200	58,500
124	Latex	3,926	361,000	104,200	N/A	N/A	361,000	104,200	58,500
Totals:		23,721					722,000	307,000	28,500

COST IMPACTS FOR REGULATORY ALTERNATIVE 1

Facility No.	Waste water ID	HAP emission reduction, lb/yr	Steam stripper		Offsite disposal		To meet the regulatory alternative		
			TCI, $	TAC, $/yr	TCI, $	TAC, $/yr	TCI, $	TAC, $/yr	Cost effectiveness, $/Mg
41	EPXCWLL201	15,870	286,000	45,600	0	98,200	0	98,200	13,600
43	Tank 1909	841	359,000	89,500	N/A	N/A	359,000	89,500	235,000
65	WW1	0	0	0	0	0	0	0	0
67	WW1	3,926	361,000	104,200	N/A	N/A	361,000	104,200	58,500
94	WW01	0	0	0	0	0	0	0	0
101	LF	0	0	0	0	0	0	0	0
119	WBP	0	0	0	0	0	0	0	0
124	Latex	3,926	361,000	104,200	N/A	N/A	361,000	104,200	58,500
Totals:		24,562					1,081,000	396,100	35,600

Attachment 2

Steam Stripper Cost Algorithms

STEAM STRIPPER COST ALGORITHM
MON\coatings analyses\Steam stripper for EPXCWLL201.xls

Design Inputs:

Assumed feed rate, gpm	5.0	Feed=(Gal)(60)/Hours
Total wastewater, gal/yr	13,500	Gal
On-Stream Time, hr/yr	45.0	Hours
HAP concentration, ppmw	209,862	Conc=(Massyr)/(Gal)/(8.33)(10^6)
HAP mass, lb/hr	524.4	Masshr=(Conc)/(10^6)(Feed)(8.3)(60)
HAP Mass, lb/yr	23,600	Massyr
HAP Identity		
L/V (feed-to-steam ratio)	25	Ratio
Steam Pressure, psig	100	Pst
Steam Temperature, K	450	Tst
Steam Hv, BTU/lb	900	HVs
Saturated steam temp, F	328	Tsat
Actual stages	10	Stage
Hap Removal	depends on Fr	
Required feed temp, F	170	Tfeed
Bottoms temp, F	210	Tbot
Wastewater temp, F	68	Tww
Overheads temp, F	170	Tov
Overhead Hvap, BTU/lb	1800	Hvov
Overheads Flow (lb/hr):	100	Massov=Feed/Ratio*60 min/hr*8.33 lb/gal
Decant Temp (F):	77	Tdec
Cool Outlet (F):	150	Tout
Bottom approach temp, F	73	Tbotapp=Tww+5
Wastewater flow, lb/hr	2,499	Massww=(Feed)(8.33 lb/gal)(60 min/hr)
Duration of SS operation, hr/yr	45.0	Hours

Cost Indices:

356.0	CE plant index July 1989
387.9	CE plant index February 1999
375.4	CE heat exchanger and tanks index July 1989
372.7	CE heat exchanger and tanks index February 1999
658.1	CE Pumps index February 1999
466.2	CE pumps index November 1988
245.2	CE fabricated equip. index Dec 1978
225.9	CE plant index Dec 1978
252.5	CE fabricated equip. index Feb.1979
230.9	CE 1st quarter 1979 in HON analysis

Column Sizing calculations

Steam density, lb/ft3	0.24	Denst=[(Pst)/(14.7)(760) + 760]+(18)/(999xTst)
Flooding Abcissa	1.54	Floodab=(Ratio)x(Denst/62.4)^0.5
Flooding Ord (for 18 in. tray spacing)	0.07	Floodord=10^[1.04635-0.64549(log(Floodab))-0.19925(log(Floodab))^2]
Velocity at Flood, ft/s	1.08	Vel=(Floodord)[(62.4-Denst)/Denst]^0.5
Percent of Flood, %	80	%Flood
Tower diameter (@80%flood), ft	1.01	D=[Massww/3600/Vel/(%Flood/100)(4)/3.1459]^0.5
Tower height, ft	17.03	H=Stage+3*D+4
Assumed wall thickness, ft	0.0521	Thick
Weight of column, lb	1,477	W=(Pi)(Thick)(501 lb/ft3)(D)(H+0.8116xD) Density is for 304 SS

Capital costs

Column cost: HON #1, $	$37,232	Cost1=1A+1B+1C(0.85)(1.189+0.0577*D)(387.9/230.9)
--shell,skirts,nozzles, manholes	$29,840	1A=[exp((6.823+0.14178*ln(W)+0.02468*(ln(W))^2)]*3.1
--platforms	$1,482	1B=151.81*(D^0.63316)*(H^0.80161)
--trays	$3,318	1C=(Stage)(278.38)*exp(0.1739*D)
Column cost: HON #2, $	$55,971	Cost2=(2A+2B+2C+2D+2E+2F+2G)(387.9/225.9)
--shell	$13,699	2A=(133.36)(W^0.6347)
--manholes	$14,271	2B=(Stage)(18)(53.83+(40.71)(Thick)(12 in/ft)) Assume 1 manhole/stage
--nozzles	$1,035	2C=(22)(24.57+35.94*Thick*12 in/ft) 22 is sum of no. of nozzles times nozzle length
--trays	$2,646	2D=(Stage)(214.54)*exp(0.2075*D)
--ladders	$220	2E=(H)(30 lb/ft of height)($0.43/lb)
--platforms and handrails	$185	2F=(D)(425 lb/ft of dia.)($0.43/lb)
--insulation	$541	2G=(3.1459)(D)(H)($10/ft2)
Column Cost: Average of Two	$46,602 TRAY	Cost=(Cost1+Cost2)/2

Tanks

Feed volume, gal	3,375	Feedvol=(Gal/4) Assume SS is operated once every 3 months
Feed tank, $	$15,750	If Feedvol>21,000 gal then COSTtk=exp(11.362-0.6104*ln(Feedvol)-0.045355*ln(Feedvol)^2)(372.7/252.5) Feedvol <21,000 gal then COSTtk=exp(2.331+1.3673*ln(Feedvol)-0.063088*ln(Feedvol)^2)(372.7/252.5)
Decanter, $	$1,839	COSTdec=[(Feed/Ratio*60*2)^0.5502]*216.8(372.7/252.5)

Pumps

Feed pump hp (for two pumps)	0.481	HPf=(Feed)(122 ft pump head)(8.33 lb/gal)/(60 s/min)/0.64*(0.001341 hp)/(0.7376 ft-lbf/s)(2) pump efficiency is 64 percent
Feed pumps cost, $	$6,776	COSTfp=(HPf)^0.4207 * (8740.7)(658.1/466.2)
Bottoms pump hp	0.241	HPb=(HPf)/(2)
Bottoms pump cost, $	$3,388	COSTbp=(COSTfp)/(2)
Overheads pump hp	0.010	HPo=(Feed)/(Ratio)(122)(8.33)/60/0.64*(0.001341)/(0.7376)
Overhead (aqueous) pump cost, $	$1,753	COSTop=(HPo)^0.4207 * (8740.7)(658.1/466.2)

Feed Preheater		
LMTD	16.83	LMTDpre=[(Tbot-Tfeed)-(Tbotapp-Tww)]/[ln((Tbot-Tfeed)/(Tbotapp-Tww))]
Area, ft2	89.08	AREApre=(Massww)(Tfeed-Tww)/(170*LMTD)
Cost, $	$6,492	If Feed<0.48 gpm then COSTpre=(4213.357*(0.48)^0.5 - 2882.31)(372.7/375.4)
		If Feed>0.48 gpm then COSTpre=(4213.357*(Feed)^0.5 - 2882.31)(372.7/375.4)
Steam Condenser		
LMTD	13.78	LMTDcond=[(Tov-Tout)-(Tdec-68)]/[ln((Tov-Tout)/(Tdec-68))]
Area, ft2	42.39	AREAcond=[(Massww)/(Ratio)(HVs)+(Massww)/(Ratio)*(Tfeed-Tdec)]/170/LMTDcond
Cost, $	$3,000	If AREAcond<240 then COSTcond=(2228.8*exp(0.00411*AREAcond))(372.7/375.4)
		If AREAcond>240 then COSTcond=(5328*exp(0.0008762*AREAcond))(372.7/375.4)
Flame Arrestor, $	$5,000	COSTarr
Equipment Cost:	$90,600	EC=COST+COSTdec+COSTtk+COSTfp+COSTbp+COSTop+COSTpre+COSTcond+COSTarr
Piping:	$27,180	Piping=(EC)(0.30)
Instrumentation (10%)	$11,778	Instr=(EC+Piping)(0.10)
Sales Tax (3%)+ Freight (5%)	$10,365	STF=(EC+Piping+Instr)(0.08)
Purchased Equipment Cost:	$139,922	PEC=EC+Piping+Instr+STF
Installation (Direct):	$76,957	Id=(PEC)(0.55)
Installation (Indirect):	$48,973	Ii=(PEC)(0.35)
Monitoring equipment		
Steam flow, liquid flow, and gas temperature monitors	$10,350	PECm
Sales Tax and freight	$828	STFm=PECm*0.08
Installation	$8,942	Im=(PECm+STFm)*0.8
Total Capital Investment:	$285,972	TCI=PEC+Id+Ii+PECm+STFm+Im
Annual costs		
Direct Annual Costs		
Utilities		
Steam	$19	Steam=(Massww)(Hours)($9.26/Mg)/(Ratio)/(2204.6 lb/Mg)
Electricity	$1	Elec=(HPf+HPb+Hpo)(0.7457)(Hours)(0.059)
Cooling water	$1	Water=(Massww)/(Ratio)(HVs)/(Tov-68)(0.00002399)(Hours)
Operator labor		
SS op hours, hr/3 months	11.3	Hourss=Hours/4
	(if process operates 52 wk/yr and SS operates once every 3 months)	
Operating labor	$506	OL=(4)/(8)(Hours)($22.50/hr) Assume 4 hours per 8 hours of operation
Supervisory labor	$76	SL=(OL)(0.15)
Maintenance labor	$506	ML=OL
Maintenance materials	$506	MM=ML
Monitoring labor	$63	MLm=(0.5hr/8hr operation)($22.50/hr)(Op hr/yr)
Monitoring maintenance materials	$50	MMm Assumed to be 10 percent of fulltime operation
Total Direct Annual Costs:	$1,741	DIRTAC=Steam+Elec+Water+Hourss+OL+SL+ML+MM+MLm+MMm
Indirect Annual Costs		
Overhead	$1,025	O=(OL+SL+ML+MM+MLm+MMm)(0.60)
Property Taxes	$2,860	PT=(TCI)(0.01)
Insurance	$2,860	INS=(TCI)(0.01)
Administrative Charges	$5,719	A=(TCI)(0.02)
Capital recovery: (7%, 15 yrs)	$31,400	CR=(TCI)(CRF=0.1098)
Total Indirect Annual Costs:	$43,863	INDTAC=O+PT+INS+A+CR
Total Annual Cost	$45,604	TAC=DIRTAC+INDTAC

STEAM STRIPPER COST ALGORITHM
MON\coatings analyses\Steam stripper for plants 67 and 124.xls

Design Inputs:

Assumed feed rate, gpm	10.0	Feed=(Gal)(60)/Hours
Total wastewater, gal/yr	500,000	Gal
On-Stream Time, hr/yr	834.0	Hours
HAP concentration, ppmw	10,000	Conc=(Massyr)/(Gal)/(8.33)(10^6)
HAP mass, lb/hr	49.9	Masshr=(Conc)/(10^6)(Feed)(8.3)(60)
HAP Mass, lb/yr	41,650	Massyr
HAP Identity		
L/V (feed-to-steam ratio)	25	Ratio
Steam Pressure, psig	100	Pst
Steam Temperature, K	450	Tst
Steam Hv, BTU/lb	900	HVs
Saturated steam temp, F	328	Tsat
Actual stages	10	Stage
Hap Removal	depends on	Fr
Required feed temp, F	170	Tfeed
Bottoms temp, F	210	Tbot
Wastewater temp, F	68	Tww
Overheads temp, F	170	Tov
Overhead Hvap, BTU/lb	1800	Hvov
Overheads Flow (lb/hr):	200	Massov=Feed/Ratio*60 min/hr*8.33 lb/gal
Decant Temp (F):	77	Tdec
Cool Outlet (F):	150	Tout
Bottom approach temp, F	73	Tbotapp=Tww+5
Wastewater flow, lb/hr	4,994	Massww=(Feed)(8.33 lb/gal)(60 min/hr)
Duration of SS operation, hr/yr	834.0	Hours

Cost Indices:

356.0	CE plant index July 1989
387.9	CE plant index February 1999
375.4	CE heat exchanger and tanks index July 1989
372.7	CE heat exchanger and tanks index February 1999
658.1	CE Pumps index February 1999
466.2	CE pumps index November 1988
245.2	CE fabricated equip. index Dec 1978
225.9	CE plant index Dec 1978
252.5	CE fabricated equip. index Feb.1979
230.9	CE 1st quarter 1979 in HON analysis

Column Sizing calculations

Steam density, lb/ft3	0.24	Denst=[(Pst)/(14.7)(760) + 760]+(18)/(999xTst)
Flooding Abcissa	1.54	Floodab=(Ratio)x(Denst/62.4)^0.5
Flooding Ord (for 18 in. tray spacing)	0.07	Floodord=10^[1.04635-0.64549(log(Floodab))-0.19925(log(Floodab))^2]
Velocity at Flood, ft/s	1.08	Vel=(Floodord)[(62.4-Denst)/Denst]^0.5
Percent of Flood, %	80	%Flood
Tower diameter (@80%flood), ft	1.43	D=[Massww/3600/Vel/(%Flood/100)(4)/3.1459]^0.5
Tower height, ft	18.28	H=Stage+3*D+4
Assumed wall thickness, ft	0.0521	Thick
Weight of column, lb	2,275	W=(Pi)(Thick)(501 lb/ft3)(D)(H+0.8116xD) Density is for 304 SS

Capital costs

Column cost: HON #1, $	$45,662	Cost1=1A+1B+1C(0.85)(1.189+0.0577*D)(387.9/230.9)
--shell,skirts,nozzles, manholes	$37,230	1A=[exp((6.823+0.14178*ln(W)+0.02468*(ln(W))^2)]*3.1
--platforms	$1,954	1B=151.81*(D^0.63316)*(H^0.80161)
--trays	$3,568	1C=(Stage)(278.38)*exp(0.1739*D)
Column cost: HON #2, $	$64,436	Cost2=(2A+2B+2C+2D+2E+2F+2G)(387.9/225.9)
--shell	$18,017	2A=(133.36)(W^0.6347)
--manholes	$14,271	2B=(Stage)(18)(53.83+(40.71)(Thick)(12 in/ft)) Assume 1 manhole/stage
--nozzles	$1,035	2C=(22)(24.57+35.94*Thick*12 in/ft) 22 is sum of no. of nozzles times nozzle length
--trays	$2,885	2D=(Stage)(214.54)*exp(0.2075*D)
--ladders	$236	2E=(H)(30 lb/ft of height)($0.43/lb)
--platforms and handrails	$261	2F=(D)(425 lb/ft of dia.)($0.43/lb)
--insulation	$821	2G=(3.1459)(D)(H)($10/ft2)
Column Cost: Average of Two	$55,049 TRAY	Cost=(Cost1+Cost2)/2

Tanks

Feed volume, gal	19,231	Feedvol=(Gal/26) Assume SS is operated once every 2 weeks
Feed tank, $	$23,602	If Feedvol>21,000 gal then COSTtk=exp(11.362-0.6104*ln(Feedvol)-0.045355*ln(Feedvol)^2)(372.7/252.5) Feedvol <21,000 gal then COSTtk=exp(2.331+1.3673*ln(Feedvol)-0.063088*ln(Feedvol)^2)(372.7/252.5)
Decanter, $	$2,691	COSTdec=[(Feed/Ratio*60*2)^0.5502]*216.8(372.7/252.5)

Pumps

Feed pump hp (for two pumps)	0.962	HPf=(Feed)(122 ft pump head)(8.33 lb/gal)/(60 s/min)/0.64*(0.001341 hp)/(0.7376 ft-lbf/s)(2) pump efficiency is 64 percent
Feed pumps cost, $	$9,067	COSTfp=(HPf)^0.4207 * (8740.7)(658.1/466.2)
Bottoms pump hp	0.481	HPb=(HPf)/(2)
Bottoms pump cost, $	$4,533	COSTbp=(COSTfp)/(2)
Overheads pump hp	0.019	HPo=(Feed)/(Ratio)(122)(8.33)/60/0.64*(0.001341)/(0.7376)
Overhead (aqueous) pump cost, $	$2,346	COSTop=(HPo)^0.4207 * (8740.7)(658.1/466.2)

Feed Preheater		
LMTD	16.83	LMTDpre=[(Tbot-Tfeed)-(Tbotapp-Tww)]/[ln((Tbot-Tfeed)/(Tbotapp-Tww))]
Area, ft2	178.02	AREApre=(Massww)(Tfeed-Tww)/(170*LMTD)
Cost, $	$10,361	If Feed<0.48 gpm then COSTpre=(4213.357*(0.48)^0.5 - 2882.31)(372.7/375.4)
		If Feed>0.48 gpm then COSTpre=(4213.357*(Feed)^0.5 - 2882.31)(372.7/375.4)
Steam Condenser		
LMTD	13.78	LMTDcond=[(Tov-Tout)-(Tdec-68)]/[ln((Tov-Tout)/(Tdec-68))]
Area, ft2	84.70	AREAcond=[(Massww)/(Ratio)(HVs)+(Massww)/(Ratio)*(Tfeed-Tdec)]/170/LMTDcond
Cost, $	$3,570	If AREAcond<240 then COSTcond=(2228.8*exp(0.00411*AREAcond))(372.7/375.4)
		If AREAcond>240 then COSTcond=(5328*exp(0.0008762*AREAcond))(372.7/375.4)
Flame Arrestor, $	$5,000	COSTarr
Equipment Cost:	$116,220	EC=COST+COSTdec+COSTtk+COSTfp+COSTbp+COSTop+COSTpre+COSTcond+COSTarr
Piping:	$34,866	Piping=(EC)(0.30)
Instrumentation (10%)	$15,109	Instr=(EC+Piping)(0.10)
Sales Tax (3%)+ Freight (5%)	$13,296	STF=(EC+Piping+Instr)(0.08)
Purchased Equipment Cost:	$179,490	PEC=EC+Piping+Instr+STF
Installation (Direct):	$98,719	Id=(PEC)(0.55)
Installation (Indirect):	$62,821	Ii=(PEC)(0.35)
Monitoring equipment		
Steam flow, liquid flow, and gas temperature monitors	$10,350	PECm sum of costs for sensors data loger, computer, etc.
Sales tax and freight	$828	STFm=PECm*0.08
Installation	$8,942	Im=(PECm+STFm)*0.8
Total Capital Investment:	$361,151	TCI=PEC+Id+Ii+PECm+STFm+Im
Annual costs		
Direct Annual Costs		
Utilities		
Steam	$700	Steam=(Massww)(Hours)($9.26/Mg)/(Ratio)/(2204.6 lb/Mg)
Electricity	$54	Elec=(HPf+HPb+Hpo)(0.7457)(Hours)(0.059)
Cooling water	$35	Water=(Massww)/(Ratio)(HVs)/(Tov-68)(0.00002399)(Hours)
Operator labor		
SS op hours, hr/2 weeks	32.1	Hourss=Hours/26
	(if process operates 52 wk/yr and SS operates once every 2 weeks)	
Operating labor	$9,383	OL=(4)/(8)(Hours)($22.50/hr) Assume 4 hours per 8 hours of operation
Supervisory labor	$1,407	SL=(OL)(0.15)
Maintenance labor	$9,383	ML=OL
Maintenance materials	$9,383	MM=ML
Monitoring labor	$1,173	MLm=(0.5 hr/8hr operation)($22.50/hr)(Op hr/yr)
Monitoring maintenance materials	$50	MMm Assumed to be 10 percent of fulltime operation
Total Direct Annual Costs:	$31,599	DIRTAC=Steam+Elec+Water+Hourss+OL+SL+ML+MM+MLm+MMm
Indirect Annual Costs		
Overhead	$18,467	O=(OL+SL+ML+MM+MLm+MMm)(0.60)
Property Taxes	$3,612	PT=(TCI)(0.01)
Insurance	$3,612	INS=(TCI)(0.01)
Administrative Charges	$7,223	A=(TCI)(0.02)
Capital recovery: (7%, 15 yrs)	$39,654	CR=(TCI)(CRF)
Total Indirect Annual Costs:	$72,567	INDTAC=O+PT+INS+A+CR
Total Annual Cost	$104,166	TAC=DIRTAC+INDTAC

STEAM STRIPPER COST ALGORITHM
MON\coatings analyses\Steam stripper for Tank1909

Design Inputs:

Assumed feed rate, gpm	10.0	Feed=(Gal)(60)/Hours
Total wastewater, gal/yr	357,000	Gal
On-Stream Time, hr/yr	595.0	Hours
HAP concentration, ppmw	3,000	Conc=(Massyr)/(Gal)/(8.33)(10^6)
HAP mass, lb/hr	15.0	Masshr=(Conc)/(10^6)(Feed)(8.3)(60)
HAP Mass, lb/yr	8,921	Massyr
HAP Identity		
L/V (feed-to-steam ratio)	25	Ratio
Steam Pressure, psig	100	Pst
Steam Temperature, K	450	Tst
Steam Hv, BTU/lb	900	HVs
Saturated steam temp, F	328	Tsat
Actual stages	10	Stage
Hap Removal	depends on	Fr
Required feed temp, F	170	Tfeed
Bottoms temp, F	210	Tbot
Wastewater temp, F	68	Tww
Overheads temp, F	170	Tov
Overhead Hvap, BTU/lb	1800	Hvov
Overheads Flow (lb/hr):	200	Massov=Feed/Ratio*60 min/hr*8.33 lb/gal
Decant Temp (F):	77	Tdec
Cool Outlet (F):	150	Tout
Bottom approach temp, F	73	Tbotapp=Tww+5
Wastewater flow, lb/hr	4,998	Massww=(Feed)(8.33 lb/gal)(60 min/hr)
Duration of SS operation, hr/yr	595.0	Hours

Cost Indices:

356.0	CE plant index July 1989
387.9	CE plant index February 1999
375.4	CE heat exchanger and tanks index July 1989
372.7	CE heat exchanger and tanks index February 1999
658.1	CE Pumps index February 1999
466.2	CE pumps index November 1988
245.2	CE fabricated equip. index Dec 1978
225.9	CE plant index Dec 1978
252.5	CE fabricated equip. index Feb.1979
230.9	CE 1st quarter 1979 in HON analysis

Column Sizing calculations

Steam density, lb/ft3	0.24	Denst=[(Pst)/(14.7)(760) + 760]+(18)/(999xTst)
Flooding Abcissa	1.54	Floodab=(Ratio)x(Denst/62.4)^0.5
Flooding Ord (for 18 in. tray spacing)	0.07	Floodord=10^[1.04635-0.64549(log(Floodab))-0.19925(log(Floodab))^2]
Velocity at Flood, ft/s	1.08	Vel=(Floodord)[(62.4-Denst)/Denst]^0.5
Percent of Flood, %	80	%Flood
Tower diameter (@80%flood), ft	1.43	D=[Massww/3600/Vel/(%Flood/100)(4)/3.1459]^0.5
Tower height, ft	18.28	H=Stage+3*D+4
Assumed wall thickness, ft	0.0521	Thick
Weight of column, lb	2,276	W=(Pi)(Thick)(501 lb/ft3)(D)(H+0.8116xD) Density is for 304 SS

Capital costs

Column cost: HON #1, $	$45,674	Cost1=1A+1B+1C(0.85)(1.189+0.0577*D)(387.9/230.9)
--shell,skirts,nozzles, manholes	$37,240	1A=[exp((6.823+0.14178*ln(W)+0.02468*(ln(W))^2)]*3.1
--platforms	$1,954	1B=151.81*(D^0.63316)*(H^0.80161)
--trays	$3,569	1C=(Stage)(278.38)*exp(0.1739*D)
Column cost: HON #2, $	$64,448	Cost2=(2A+2B+2C+2D+2E+2F+2G)(387.9/225.9)
--shell	$18,023	2A=(133.36)(W^0.6347)
--manholes	$14,271	2B=(Stage)(18)(53.83+(40.71)(Thick)(12 in/ft)) Assume 1 manhole/stage
--nozzles	$1,035	2C=(22)(24.57+35.94*Thick*12 in/ft) 22 is sum of no. of nozzles times nozzle length
--trays	$2,885	2D=(Stage)(214.54)*exp(0.2075*D)
--ladders	$236	2E=(H)(30 lb/ft of height)($0.43/lb)
--platforms and handrails	$261	2F=(D)(425 lb/ft of dia.)($0.43/lb)
--insulation	$822	2G=(3.1459)(D)(H)($10/ft2)
Column Cost: Average of Two	$55,061 TRAY	Cost=(Cost1+Cost2)/2

Tanks

Feed volume, gal	14,875	Feedvol=(Gal/24) Assume SS is operated once every two weeks
Feed tank, $	$22,775	If Feedvol>21,000 gal then COSTtk=exp(11.362-0.6104*ln(Feedvol)-0.045355*ln(Feedvol)^2)(372.7/252.5) Feedvol <21,000 gal then COSTtk=exp(2.331+1.3673*ln(Feedvol)-0.063088*ln(Feedvol)^2)(372.7/252.5)
Decanter, $	$2,693	COSTdec=[(Feed/Ratio*60*2)^0.5502]*216.8(372.7/252.5)

Pumps

Feed pump hp (for two pumps)	0.962	HPf=(Feed)(122 ft pump head)(8.33 lb/gal)/(60 s/min)/0.64*(0.001341 hp)/(0.7376 ft-lbf/s)(2) pump efficiency is 64 percent
Feed pumps cost, $	$9,070	COSTfp=(HPf)^0.4207 * (8740.7)(658.1/466.2)
Bottoms pump hp	0.481	HPb=(HPf)/(2)
Bottoms pump cost, $	$4,535	COSTbp=(COSTfp)/(2)
Overheads pump hp	0.019	HPo=(Feed)/(Ratio)(122)(8.33)/60/0.64*(0.001341)/(0.7376)
Overhead (aqueous) pump cost, $	$2,347	COSTop=(HPo)^0.4207 * (8740.7)(658.1/466.2)

Feed Preheater		
LMTD	16.83	LMTDpre=[(Tbot-Tfeed)-(Tbotapp-Tww)]/[ln((Tbot-Tfeed)/(Tbotapp-Tww))]
Area, ft2	178.17	AREApre=(Massww)(Tfeed-Tww)/(170*LMTD)
Cost, $	$10,366	If Feed<0.48 gpm then COSTpre=(4213.357*(0.48)^0.5 - 2882.31)(372.7/375.4)
		If Feed>0.48 gpm then COSTpre=(4213.357*(Feed)^0.5 - 2882.31)(372.7/375.4)
Steam Condenser		
LMTD	13.78	LMTDcond=[(Tov-Tout)-(Tdec-68)]/[ln((Tov-Tout)/(Tdec-68))]
Area, ft2	84.77	AREAcond=[(Massww)/(Ratio)(HVs)+(Massww)/(Ratio)*(Tfeed-Tdec)]/170/LMTDcond
Cost, $	$3,571	If AREAcond<240 then COSTcond=(2228.8*exp(0.00411*AREAcond))(372.7/375.4)
		If AREAcond>240 then COSTcond=(5328*exp(0.0008762*AREAcond))(372.7/375.4)
Flame Arrestor, $	$5,000	COSTarr
Equipment Cost:	$115,417	EC=COST+COSTdec+COSTtk+COSTfp+COSTbp+COSTop+COSTpre+COSTcond+COSTarr
Piping:	$34,625	Piping=(EC)(0.30)
Instrumentation (10%)	$15,004	Instr=(EC+Piping)(0.10)
Sales Tax (3%)+ Freight (5%)	$13,204	STF=(EC+Piping+Instr)(0.08)
Purchased Equipment Cost:	$178,250	PEC=EC+Piping+Instr+STF
Installation (Direct):	$98,038	Id=(PEC)(0.55)
Installation (Indirect):	$62,388	Ii=(PEC)(0.35)
Monitoring equipment		
Steam flow, liquid flow, and gas temperature monitors	$10,350	PECm Sum of costs for sensors, data logger, computer, etc.
Sales tax and freight	$828	STFm=PECm*0.08
Installation	$8,942	Im=(PECm+STFm)*0.8
Total Capital Investment:	$358,796	TCI=PEC+Id+Ii+PECm+STFm+Im
Annual costs		
Direct Annual Costs		
Utilities		
Steam	$500	Steam=(Massww)(Hours)($9.26/Mg)/(Ratio)/(2204.6 lb/Mg)
Electricity	$38	Elec=(HPf+HPb+Hpo)(0.7457)(Hours)(0.059)
Cooling water	$25	Water=(Massww)/(Ratio)(HVs)/(Tov-68)(0.00002399)(Hours)
Operator labor		
SS op hours, hr/2 weeks	24.8	Hourss=Hours/24
	(if process operates 52 wk/yr and SS operates once every two weeks)	
Operating labor	$6,694	OL=(4)/(8)(Hours)($22.50/hr) Assume 4 hours per 8 hours of operation
Supervisory labor	$1,004	SL=(OL)(0.15)
Maintenance labor	$6,694	ML=OL
Maintenance materials	$6,694	MM=ML
Monitoring labor	$837	Mlm=(0.5hr/8hr operation)($22.50/hr)(Op hr/yr)
Monitoring maintenance materials	$50	MMm Assumed to be equal to 10 percent of fulltime operation value
Total Direct Annual Costs:	$22,560	DIRTAC=Steam+Elec+Water+Hourss+OL+SL+ML+MM+MLm+MMm
Indirect Annual Costs		
Overhead	$13,183.22	O=(OL+SL+ML+MM+MLm+MMm)(0.60)
Property Taxes	$3,588	PT=(TCI)(0.01)
Insurance	$3,588	INS=(TCI)(0.01)
Administrative Charges	$7,176	A=(TCI)(0.02)
Capital recovery: (7%, 15 yrs)	$39,396	CR=(TCI)(CRF)
Total Indirect Annual Costs:	$66,931	INDTAC=O+PT+INS+A+CR
Total Annual Cost	$89,491	TAC=DIRTAC+INDTAC

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Date: March 8, 2000
(Revised September 15, 2000)

To: MON Project Files

From: David Randall
Doug Lincoln

Subject: MACT Floor, Regulatory Alternatives, and Nationwide Impacts for Process Vessels at Coatings Manufacturing Facilities
Miscellaneous Organic NESHAP
EPA Project No. 95/08; MRI Project No. 104803.1.049

I. Introduction

This memorandum describes the procedures used to calculate nationwide impacts of regulatory alternatives for process vessels at coatings manufacturing facilities. Some of the procedures have been revised from earlier analyses.[1] The revisions include adding control costs for portable vessels under the regulatory alternative (the equation to calculate these costs was inadvertently left out of the costing algorithm), evaluating control costs only for condensers rather than both condensers and carbon adsorbers, and correcting minor inconsistencies in the costing algorithm for control devices. As a result of these changes, the cost to control portable vessels to a level above the MACT floor is not reasonable. Therefore, we recommend developing separate standards for portable and stationary vessels.

II. Summary of the MACT Floor and Regulatory Alternatives

A. Existing Sources

In previous analyses, the MACT floor for stationary process vessels at existing sources was determined to be a cover and a 60 percent reduction in emissions, and the MACT floor for portable vessels was determined to be a cover.[2,3] Previous analyses also evaluated impacts for regulatory alternatives more stringent than the existing source MACT floor; for both stationary and portable vessels, the regulatory alternatives consisted of a cover and a 75 percent reduction.[1] The control level of 75 percent was selected as the maximum feasible reduction for vessels with removable covers. Because these covers have ungasketed openings for protruding equipment, it was assumed that emissions would be controlled by drawing air across the openings to capture emissions, which would then be routed to a control device. The necessary air flows would dilute the emissions to concentrations estimated to be less than 100 ppmv. At these concentrations, control using condensers would be impractical, and carbon adsorbers operated to achieve an outlet concentration of 20 ppmv would be limited to a control efficiency of little more than 75 percent.

However, more than 70 percent of stationary vessels at coatings manufacturing facilities have fixed covers. With fixed covers, emission streams at 77EF that are saturated with either toluene or xylene (the two most prevalent HAPs at coatings facilities, and HAPs with relatively low vapor pressures) can be controlled to a maximum of about 75 percent by operating a condenser at about 35EF, and a precooler would not be required to remove water vapor to prevent icing. Thus, the regulatory alternative for which impacts are estimated in this analysis is also based on a control level of 75 percent. Table 1 summarizes the MACT floor and regulatory alternative requirements.

B. New Sources

The MACT floor for both stationary and portable vessels at new sources was determined to be 95 percent control.[3] Because this is a very high level of control, and more stringent than the regulatory alternative for existing sources, no regulatory alternative was developed for new sources. Table 1 summarizes the requirements for the MACT floor.

TABLE 1. MACT FLOOR AND REGULATORY ALTERNATIVES FOR EXISTING AND NEW SOURCES

Type of source	Regulatory alternative	Type of process vessel	Control requirement	Applicability cutoff (vessel size, gal)
Existing	MACT floor	Portable	Cover	250
		Stationary	60 percent reduction	250
	Regulatory alternative	Portable	75 percent reduction	250
		Stationary	75 percent reduction	250
New	MACT floor	Portable	95 percent reduction	250
		Stationary	95 percent reduction	250

III. Impacts Analyses for Existing Sources

The costs, emission reductions, and cost effectiveness of the MACT floor and regulatory alternative for stationary and portable vessels at existing sources are summarized in Table 2. The procedures used to develop these impacts are described in the remainder of this memorandum.

TABLE 2. IMPACTS OF REGULATORY ALTERNATIVES FOR EXISTING SOURCES

Regulatory alternative	Type of vessel	Emission reduction, Mg/yr	Total capital investment, $ (million)	Total annual cost, $/yr	Cost effectiveness, $/Mg	
					Relative to baseline	Incremental
MACT floor	Portable	2.2	0.65	97,800	44,900	N/A
	Stationary	3,360	54.2	14,300,000	4,260	N/A
Regulatory alternative	Portable	445	31.6	9,310,000	20,900	20,800
	Stationary	5,050	55.1	14,170,000	2,550	(80)

A. Emissions Estimation Methodology

Data provided by the coatings manufacturers in responses to the Information Collection Request (ICR) included the number of vessels, vessel capacity, and control devices. Information about the HAP content and throughput of material stored in storage tanks was also provided. Using this information, uncontrolled and baseline emissions, MACT and above the floor emissions reductions estimates were calculated.

The nationwide uncontrolled, baseline, and controlled emissions are summarized in Table 3. The tables in Attachments 1 and 2 present the estimated uncontrolled emissions for stationary vessels, and the tables in Attachments 3 and 4 present the uncontrolled emissions for portable vessels.

TABLE 3. NATIONWIDE EMISSIONS SUMMARY

Type of vessel	Uncontrolled emissions, Mg/yr	Baseline emissions, Mg/yr	Controlled emissions, Mg/yr	
			MACT floor	Regulatory alternative
Portable	610	537	535	92
Stationary	7,190	6,140	2,780	1,095
Total	7,800	6,680	3,320	1,190

1. Uncontrolled Emissions Estimates. Uncontrolled HAP emissions were assumed to be equal to 1 percent of the total HAP throughput. This factor is roughly equivalent to the AP-42 emission factor of 1.5 lb VOC/100 lb product for paint manufacturing.[4] The total HAP throughput was estimated as part of the storage tank analysis.[5] The emissions for each process

vessel was estimated based on the ratio of its capacity to the total capacity of all vessels at the facility. For example, if one process vessel has a capacity of 1,000 gal, and the total capacity of all process vessels at the facility is 50,000 gal, 2 percent of the total estimated HAP emissions were allotted to this vessel.

2. Baseline Emissions Estimates. Baseline emissions were calculated for each vessel. For vessels with add-on control devices, the reported control efficiencies were used with the estimated uncontrolled emissions to estimate baseline emissions. For vessels controlled with only a cover, baseline emissions were assumed to be equal to 90 percent of the uncontrolled emissions.

3. Regulatory Alternative Emission Reductions Estimates. Emission reductions that would be achieved by the MACT floor and the regulatory alternative were also estimated for each grouping of vessels at a facility. The estimates were based on the uncontrolled emission level, the current level of control, and the required level of control. As discussed above for baseline emissions, covers alone were assumed to reduce emissions by 10 percent. Figures 1 and 2 present the steps in the analysis and the resulting reduction for each scenario of vessel type and existing control.

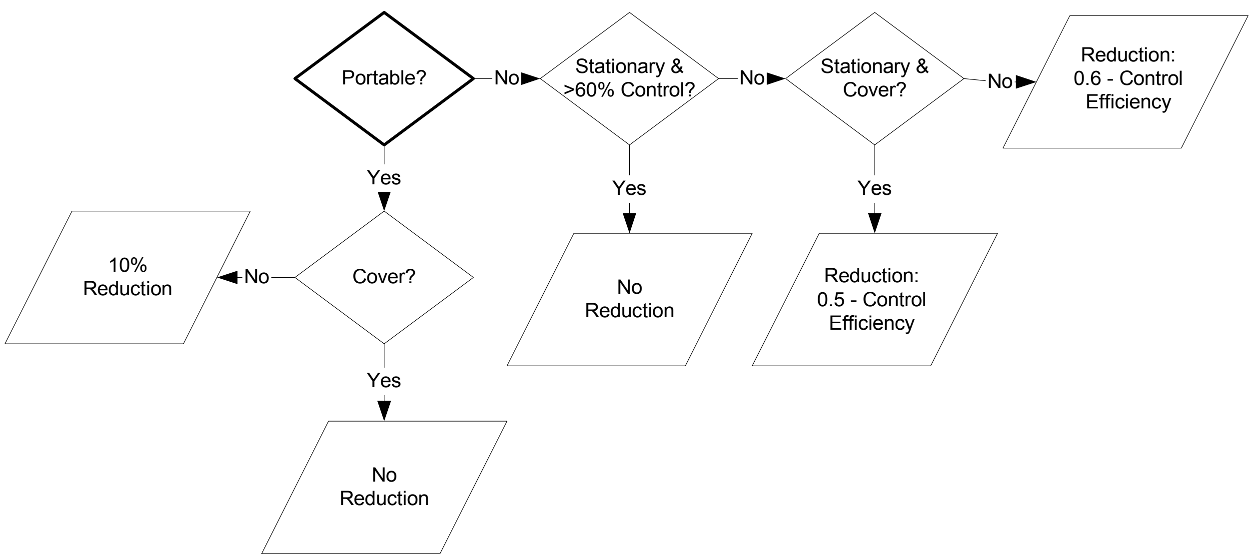

Figure 1. Flow chart to estimate MACT floor reductions.

4. Nationwide Emissions Estimates. The data provided by the coatings manufacturers in responses to the ICR were sufficient to estimate the emissions for 60 of the 127 facilities in the database. Nationwide emissions estimates were developed assuming that the 60 facilities are representative of all 127 facilities. Thus, nationwide emissions were estimated to be 2.12 times the emissions for the 60 facilities (i.e., 127/60 = 2.12). A single factor was developed for both portable and stationary vessels because a majority of facilities have both types of vessels.

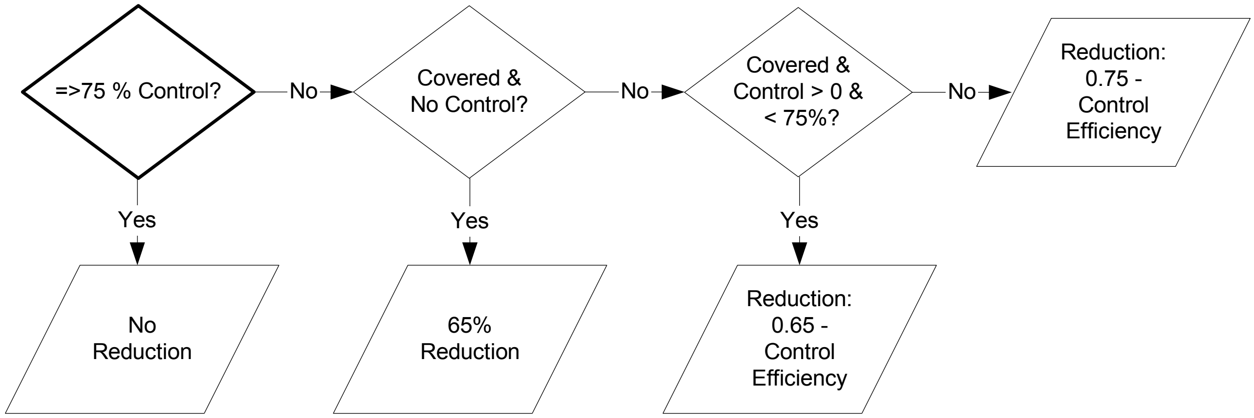

Figure 2. Flow chart of emission reductions for the regulatory alternative.

B. Cost Estimation Methodology

Costs were estimated for covers and refrigerated condenser units. The procedures used are presented in the following sections. The costs were calculated for groupings of vessels at each facility. The groupings were developed based on the type of vessel and the existing level of control. The level of control was divided into three additional categories: no cover, control level below the level of the regulatory alternative, and control level above the level of the regulatory alternative. The following groupings were developed:

- All portable vessels without covers
- All portable vessels with covers and control level below the regulatory alternative
- All portable vessels with control above the regulatory alternative
- All stationary vessels without covers
- All stationary vessels with covers and control level below the regulatory alternative
- All stationary vessels with control above the regulatory alternative

1. Cover Cost. For each vessel without a cover, the cost of a stainless steel cover plus installation was calculated. The cost of a 10 ft diameter fixed cover was estimated to be $3,600 (Attachment 5 presents data and assumptions used to develop this estimate).[6] Assuming the diameter is equal to the height of the vessel, the diameter of a 7,500 gal vessel is 10 ft. This size was used as a model for all vessels without covers because one value simplifies the analysis, and it gives a conservative estimate because most vessels are smaller than 7,500 gal. Factors used to estimate the other elements of the total capital investment (TCI) and the total annual cost (TAC) are presented in Table 4.

TABLE 4. FACTORS USED TO ESTIMATE TCI AND TAC FOR COVERS

Parameter	Cost, 1999 dollars
Capital costs	
Equipment costs (EC)	3,600
Sales tax and freight (SF)	0.08 x EC
Installation (I)	0.15 x (EC + SF)
Total capital investment (TCI)	EC + I + SF
Annual costs	
Capital recovery[a]	0.1098 x TCI
Administration, property tax, and insurance	0.04 x TCI
Total annual cost	0.1498 x TCI

[a] The capital recovery factor is based on a 15-yr life and a 7 percent interest rate.

2. Refrigerated Condenser System. For the reasons discussed in section II.A of this memorandum, a refrigerated condenser system was selected as the control device to meet the percent reduction requirement of the MACT floor or regulatory alternative for all vessels. The design of this system consists of a single large refrigeration unit for each grouping of vessels at a facility. For each process vessel in the grouping, the system also includes an individual condenser, 50 ft of 2-in diameter schedule 40 steel pipe to route coolant from the common refrigeration unit to the condenser, and a 2-in cast steel plug valve.

The cost of the refrigeration units were estimated using the OAQPS algorithm for custom refrigerated condensers.[7] For each grouping of vessels, the refrigeration unit size and cost was based on a model gas stream with the following characteristics:

1. Flow rate of 100 scfm,
2. Temperature of 77EF (25EC), and
3. Toluene concentration of 40,000 ppmv.

The flow rate is based on the assumption that no more than 5 vessels would be filled simultaneously (at a rate of 150 gal/min, or 20 scfm). Toluene was selected as the HAP in the gas stream due to its prevalence in coatings manufacturing, and it was assumed that the displaced vapor is in equilibrium with pure toluene liquid. The algorithms for the condensers used to meet the MACT floor and regulatory alternative a presented in Attachments 6 and 7, respectively. Costs for the refrigeration unit were escalated to February 1999 dollars using the appropriate Vatavuk Air Pollution Control Cost Indexes for refrigeration systems, as presented in Attachments 6 and 7.

The condensers for the individual vessels were also calculated using an equation in the OAQPS Cost Manual.[7] However, because the calculated surface area for most of the condensers is below the lower end of the applicable range for the equation, we took a conservative approach and estimated the cost for each condenser using the minimum applicable area for the equation (i.e, 38 ft^2). These costs were escalated from April 1998 dollars to February 1999 dollars using the Chemical Engineering cost indexes for heat exchangers and tanks.[8,9] The cost of a storage/recovery tank for the condenser was not included because it is assumed that the recovered product would be returned to the process or storage vessels from which it originated.

Piping and valve costs were estimated using unit costs from section F.1 of the HON BID Volume 1B.[10] These costs were escalated from April 1988 to February 1999 dollars using the Chemical Engineering cost indexes for pipe, valves, and fittings.[8,11]

Based on the above data and procedures, the following equation was developed to calculate the TCI for each refrigerated condenser system:

$$\begin{aligned} \text{TCI} = & \left(\text{RU} * (1 + 0.08 + 0.1) * 1.74\right) \\ & + (\text{C} + \text{P} + \text{V})(\text{N})(1.08)(1.15) \\ & + (\text{M} + (\text{T})(\text{N}))(1 + 0.08)(1.8) \end{aligned}$$

Where:

RU	=	Refrigeration unit cost
0.1	=	Instrumentation factor for the refrigeration unit
1.74	=	Installation factor for the refrigeration unit
C	=	Condenser cost
P	=	Piping cost
V	=	Valve cost
N	=	Number of vessels in the grouping
T	=	Thermocouple and wire for each condenser
M	=	Datalogger, computer, printer, and software
0.08	=	Sales tax and freight factor
1.15	=	Installation factor for the condenser, piping, and valve
1.8	=	Installation factor for the monitoring equipment

The values for all of the variables except the number of vessels are presented in Table 5. Substituting these values in the equation and simplifying results in the following for the MACT floor:

$$\text{TCI} = 43{,}628 + 8{,}103\text{xN}$$

and the following for the regulatory alternative:

$$\text{TCI} = 49{,}667 + 8{,}103\text{xN}$$

TABLE 5. VALUES FOR VARIABLES IN EQUATION TO CALCULATE TCI FOR REFRIGERATED CONDENSER UNITS

Equipment	Unit cost	Base cost, $	Escalated cost, $	Escalation factors
Refrigeration unit, one per refrigeration unit				
• MACT floor		15,264	15,568	See Attachment 6
• Regulatory alternative		18,148	18,509	See Attachment 7
Condenser, one per vessel		5,067	5,070	CE heat exchanger and tanks indexes for Jul 1990 and Feb 1999 (372.7/372.5)
Piping, 50 ft per vessel	$2.61/ft	130	163	CE indexes for pipe, valves, and fittings for Apr 1988 and Feb 1999 (533.5/427.5)
Valve, one per vessel		784	978	CE indexes for pipe, valves, and fittings for Apr 1988 and Feb 1999 (533.5/427.5)
Monitoring equipment (thermocouple and wire), one per condenser		200	200	
Monitoring equipment (datalogger, computer, printer, and software), one per refrigeration unit		6,000	6,000	

The TAC for each refrigerated condenser system consists of the direct annual costs and overhead for the refrigeration unit, the capital recovery and other indirect costs based on the TCI for the entire system, and a credit for material recovered by the condenser. The direct annual costs and overhead for the condenser system were estimated to be $38,627 for the MACT floor and $39,406 for the regulatory alternative. The individual elements of the direct annual costs are presented in Attachments 6 and 7 for the MACT floor and regulatory alternative, respectively. The combined direct annual costs and overhead costs for the monitoring equipment were estimated to be $15,875 (This includes $9,920/yr for labor, $500/yr for materials, and $5,953/yr for overhead). The capital recovery is estimated based on a 15-yr equipment life and an interest rate of 7 percent. The recovery credit is based on the emission reductions achieved by the MACT floor or the regulatory alternative and a toluene salvage value of $0.1/lb. This information was used to develop the following equation to calculate the TAC:

$$\begin{aligned} TAC = {} & Control + (0.1498xTCI) \\ & - (0.1x\,Reduc) + Monit \end{aligned}$$

Where:

Control	=	Direct annual costs and overhead for the condenser system
0.1498	=	Capital recovery factor plus factor for administrative charges, property tax, and insurance
TCI	=	Total capital investment for the refrigeration unit, condensers, piping, and valves
0.1	=	Toluene salvage value, \$/lb
Reduc	=	Emission reduction due to the MACT floor or regulatory alternative, lb/yr
Monit	=	Direct annual costs and overhead for monitoring equipment (\$15,875/yr)

The nationwide TCI and TAC were estimated by scaling up the costs using the same procedures described above for the emissions (i.e., the totals for the 60 facilities for which costs were calculated were multiplied by 2.12).

IV. References

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ATTACHMENT 1

MACT Floor Emissions and Cost Impacts for Stationary Vessels

Coating Mfg. Process Vessels (MACT Floor) – Stationary Vessels

	Facility #	Portable or Stationary	Uncontrolled HAP Emissions (lb/yr)	Vessel Count	Cover Count	Condenser Count	MACT	Baseline HAP Emissions (lb/yr)	MACT Floor HAP Reduction (lb/yr)	MACT Floor TCI	MACT Floor TAC ($/yr)	MACT Floor CE ($/ton)	Control Technology
1	1	S	669,883	7	0	7	No	602,894	334,941	$100,345	$36,041	$215	Condenser
2	4	S	88,457	19	0	19	No	50,126	7,371	$197,575	$83,363	$22,618	Condenser
3	5	S	12,734	0	0	4	Yes	2,420	0	$0	$0	$0	None
4	6	S	37,502	1	1	1	No	37,502	22,501	$56,202	$60,672	$5,393	Cover&Condenser
5	9	S	10,500	0	0	2	No	9,450	5,250	$59,833	$62,941	$23,978	Condenser
6	10	S	958	2	2	2	No	958	575	$68,776	$64,748	$225,253	Cover&Condenser
7	10	S	9,102	1	0	10	No	8,192	4,551	$124,653	$72,721	$31,957	Condenser
8	13	S	22,358	0	0	8	No	20,122	11,179	$108,448	$69,631	$12,457	Condenser
9	14	S	469,515	0	0	12	No	422,564	234,758	$140,858	$52,128	$444	Condenser
10	15	S	305,291	38	0	38	No	274,762	152,646	$351,522	$91,896	$1,204	Condenser
11	16	S	11,766	21	0	33	No	10,589	5,883	$311,010	$100,504	$34,168	Condenser
12	17	S	97,021	12	0	12	No	87,319	48,510	$140,858	$70,752	$2,917	Condenser
13	21	S	98,915	13	0	13	No	89,023	49,457	$148,960	$71,872	$2,906	Condenser
14	29	S	55,015	6	0	39	No	49,514	27,508	$359,624	$105,624	$7,680	Condenser
15	32	S	15,529	28	28	28	No	15,529	9,317	$395,691	$112,846	$24,223	Cover&Condenser
16	34	S	8,718	0	0	2	Yes	1,656	0	$0	$0	$0	None
17	34	S	44,895	25	0	25	No	40,406	22,448	$246,190	$89,137	$7,942	Condenser
18	39	S	699,568	213	0	213	No	629,611	349,784	$1,769,453	$284,589	$1,627	Condenser
19	40	S	23,963	23	0	23	No	21,567	11,982	$229,985	$87,757	$14,649	Condenser
20	41	S	59,210	0	0	54	No	53,289	29,605	$481,161	$123,620	$8,351	Condenser
21	42	S	212,687	14	0	28	No	191,419	106,344	$270,497	$84,389	$1,587	Condenser
22	42	S	159,421	0	0	113	Yes	31,406	0	$0	$0	$0	None
23	43	S	870,908	171	0	171	No	783,817	435,454	$1,429,150	$225,044	$1,034	Condenser
24	44	S	3,414	3	0	3	No	3,073	1,707	$67,936	$64,509	$75,579	Condenser
25	47	S	325,137	72	0	72	No	292,623	162,568	$627,006	$132,172	$1,626	Condenser
26	50	S	41,765	16	0	16	No	37,588	20,882	$173,268	$78,370	$7,506	Condenser
27	51	S	34,423	34	0	34	No	30,980	17,211	$319,112	$100,585	$11,688	Condenser
28	52	S	9,363	37	0	49	No	8,427	4,682	$440,649	$120,044	$51,284	Condenser
29	53	S	680	6	6	6	No	680	408	$119,070	$72,299	$354,295	Cover&Condenser
30	53	S	8,503	2	0	32	No	7,652	4,251	$302,907	$99,453	$46,787	Condenser
31	54	S	37,715	0	0	19	No	33,944	18,858	$197,575	$82,214	$8,719	Condenser
32	56	S	5,124	11	0	11	No	4,612	2,562	$132,755	$74,134	$57,871	Condenser
33	59	S	125,670	126	0	126	No	113,103	62,835	$1,064,539	$207,687	$6,611	Condenser
34	59	S	45,620	0	0	8	Yes	15,967	0	$0	$0	$0	None
35	61	S	184,090	0	0	24	No	166,287	91,894	$238,087	$80,979	$1,762	Condenser
36	64	S	459,735	149	0	149	No	413,762	229,868	$1,250,895	$218,900	$1,905	Condenser
37	65	S	77,680	0	0	33	No	69,912	38,840	$311,010	$97,208	$5,006	Condenser
38	66	S	73,803	1	0	63	No	66,423	36,902	$554,083	$133,815	$7,253	Condenser

Coating Mfg. Process Vessels (MACT Floor) – Stationary Vessels (continued)

	Facility #	Portable or Stationary	Uncontrolled HAP Emissions (lb/yr)	Vessel Count	Cover Count	Condenser Count	MACT	Baseline HAP Emissions (lb/yr)	MACT Floor HAP Reduction (lb/yr)	MACT Floor TCI	MACT Floor TAC ($/yr)	MACT Floor CE ($/ton)	Control Technology
39	67	S	67,444	0	0	126	No	60,699	33,722	$1,064,539	$210,599	$12,490	Condenser
40	68	S	58,553	1	0	11	No	52,698	29,277	$132,755	$71,462	$4,882	Condenser
41	69	S	18,427	32	0	39	No	16,584	9,214	$359,624	$107,453	$23,325	Condenser
42	69	S	15,240	0	0	30	Yes	762	0	$0	$0	$0	None
43	70	S	21,626	0	0	52	No	19,464	10,813	$464,956	$123,072	$22,763	Condenser
44	71	S	2,156	0	0	163	No	1,940	1,078	$1,364,330	$258,772	$480,152	Condenser
45	72	S	10,423	7	0	27	No	9,380	5,211	$262,395	$93,289	$35,802	Condenser
46	73	S	16,317	161	0	161	No	14,685	8,159	$1,348,125	$255,636	$62,667	Condenser
47	76	S	38,501	54	0	110	No	34,651	19,251	$934,899	$192,626	$20,012	Condenser
48	76	S	128	0	0	3	Yes	6	0	$0	$0	$0	None
49	77	S	32,968	0	0	84	Yes	1,648	0	$0	$0	$0	None
50	78	S	198,460	153	0	153	No	178,614	99,230	$1,283,305	$236,819	$4,773	Condenser
51	78	S	99,117	0	0	29	Yes	4,956	0	$0	$0	$0	None
52	79	S	2,334	0	0	8	No	2,101	1,167	$108,448	$70,632	$121,030	Condenser
53	81	S	122,793	47	0	47	No	110,514	61,397	$424,444	$111,945	$3,647	Condenser
54	84	S	115,383	5	0	5	No	103,845	57,691	$84,141	$61,338	$2,126	Condenser
55	85	S	27,883	23	0	23	No	25,095	13,942	$229,985	$87,561	$12,561	Condenser
56	86	S	90,651	18	0	28	No	81,586	45,325	$270,497	$90,491	$3,993	Condenser
57	88	S	1,724	41	0	42	No	1,551	862	$383,932	$111,930	$259,722	Condenser
58	90	S	1,829	0	0	3	No	1,646	915	$67,936	$64,588	$141,249	Condenser
59	90	S	9,603	0	0	9	Yes	1,440	0	$0	$0	$0	None
60	94	S	9,478	2	0	14	No	8,530	4,739	$157,063	$77,557	$32,733	Condenser
61	98	S	88,565	64	0	75	No	79,708	44,282	$651,313	$147,641	$6,668	Condenser
62	99	S	35,461	63	0	63	No	31,915	17,731	$554,083	$135,732	$15,310	Condenser
63	102	S	42,802	0	0	16	Yes	428	0	$0	$0	$0	None
64	102	S	123,753	57	0	57	No	111,378	61,877	$505,469	$124,035	$4,009	Condenser
65	103	S	12,749	70	0	70	No	11,474	6,375	$610,801	$145,363	$45,607	Condenser
66	106	S	767,396	13	0	14	No	690,656	383,698	$157,063	$39,661	$207	Condenser
67	107	S	123	13	0	13	No	107	57	$148,960	$76,812	$2,706,252	Condenser
68	112	S	29,943	15	0	20	No	26,948	14,971	$205,678	$83,816	$11,197	Condenser
69	115	S	10,366	68	0	68	No	9,329	5,183	$594,596	$143,055	$55,204	Condenser
70	119	S	4,993	35	0	51	No	4,494	2,496	$456,854	$122,690	$98,293	Condenser
Total			7,493,828					6,398,003	3,502,193	$25,615,874	$6,757,219	$3,859	
National Total			15,861,936					13,542,441	7,412,975	$54,220,267	$14,302,780	$3,859	

ATTACHMENT 2

Regulatory Alternative Emissions and Cost Impacts for Stationary Vessels

Coating Mfg. Process Vessels (Above Floor) – Stationary Vessels

	Facility #	Portable or Stationary	Uncontrolled HAP Emissions (lb/yr)	Vessel Count	Cover Count	Condenser Count	MACT	Baseline HAP Emissions (lb/yr)	Above Floor HAP Reduction (lb/yr)	Above Floor TCI	Above Floor TAC ($/yr)	Above Floor CE ($/ton)	Control Technology
1	1	S	669,883	7	0	7	No	602,894	502,412	$106,384	$20,977	$84	Condenser
2	4	S	88,457	19	0	19	No	50,126	22,114	$203,614	$83,572	$7,558	Condenser
3	5	S	12,734	4	0	0	Yes	2,420	0	$0	$0	$0	None
4	6	S	37,502	1	1	1	No	37,502	28,126	$62,240	$61,793	$4,394	Cover&Condenser
5	9	S	10,500	2	0	0	No	9,450	7,875	$65,872	$64,362	$16,346	Condenser
6	10	S	958	2	2	2	No	958	719	$74,814	$66,417	$184,847	Cover&Condenser
7	10	S	9,102	10	0	1	No	8,192	6,827	$130,691	$74,177	$21,731	Condenser
8	13	S	22,358	8	0	0	No	20,122	16,769	$114,486	$70,755	$8,439	Condenser
9	14	S	469,515	12	0	0	No	422,564	352,137	$146,896	$42,073	$239	Condenser
10	15	S	305,291	38	0	38	No	274,762	228,968	$357,560	$85,948	$751	Condenser
11	16	S	11,766	33	0	21	No	10,589	8,824	$317,048	$101,893	$23,094	Condenser
12	17	S	97,021	12	0	12	No	87,319	72,765	$146,896	$70,011	$1,924	Condenser
13	21	S	98,915	13	0	13	No	89,023	74,186	$154,999	$71,082	$1,916	Condenser
14	29	S	55,015	39	0	6	No	49,514	41,261	$365,663	$105,932	$5,135	Condenser
15	32	S	15,529	28	28	28	No	15,529	11,647	$401,729	$114,296	$19,627	Cover&Condenser
16	34	S	44,895	25	0	25	No	40,406	33,672	$252,228	$89,699	$5,328	Condenser
17	34	S	8,718	2	0	0	Yes	1,656	0	$0	$0	$0	None
18	39	S	699,568	213	0	213	No	629,611	524,676	$1,775,492	$268,783	$1,025	Condenser
19	40	S	23,963	23	0	23	No	21,567	17,972	$236,023	$88,841	$9,886	Condenser
20	41	S	59,210	54	0	0	No	53,289	44,408	$487,200	$123,824	$5,577	Condenser
21	42	S	212,687	28	0	14	No	191,419	159,516	$276,536	$80,755	$1,013	Condenser
22	42	S	159,421	113	0	0	Yes	31,406	0	$0	$0	$0	None
23	43	S	870,908	171	0	171	No	783,817	653,181	$1,435,188	$204,955	$628	Condenser
24	44	S	3,414	3	0	3	No	3,073	2,561	$73,974	$66,107	$51,634	Condenser
25	47	S	325,137	72	0	72	No	292,623	243,853	$633,044	$125,727	$1,031	Condenser
26	50	S	41,765	16	0	16	No	37,588	31,324	$179,306	$79,010	$5,045	Condenser
27	51	S	34,423	34	0	34	No	30,980	25,817	$325,150	$101,408	$7,856	Condenser
28	52	S	9,363	49	0	37	No	8,427	7,022	$446,687	$121,494	$34,602	Condenser
29	53	S	680	6	6	6	No	680	510	$125,109	$73,972	$289,995	Cover&Condenser
30	53	S	8,503	32	0	2	No	7,652	6,377	$308,946	$100,924	$31,652	Condenser
31	54	S	37,715	19	0	0	No	33,944	28,287	$203,614	$82,955	$5,865	Condenser
32	56	S	5,124	11	0	11	No	4,612	3,843	$138,794	$75,689	$39,390	Condenser
33	59	S	171,290	134	0	134	No	129,070	94,253	$1,135,397	$215,939	$4,582	Condenser
34	61	S	184,090	24	0	0	No	166,287	137,160	$244,126	$78,136	$1,139	Condenser
35	64	S	459,735	149	0	149	No	413,762	344,801	$1,256,934	$209,091	$1,213	Condenser
36	65	S	77,680	33	0	0	No	69,912	58,260	$317,048	$96,950	$3,328	Condenser
37	66	S	73,803	63	0	1	No	66,423	55,352	$560,122	$133,653	$4,829	Condenser
38	67	S	67,444	126	0	0	No	60,699	50,583	$1,070,577	$210,596	$8,327	Condenser

Coating Mfg. Process Vessels (Above Floor) – Stationary Vessels (continued)

	Facility #	Portable or Stationary	Uncontrolled HAP Emissions (lb/yr)	Vessel Count	Cover Count	Condenser Count	MACT	Baseline HAP Emissions (lb/yr)	Above Floor HAP Reduction (lb/yr)	Above Floor TCI	Above Floor TAC ($/yr)	Above Floor CE ($/ton)	Control Technology
39	68	S	58,553	11	0	1	No	52,698	43,915	$138,794	$71,682	$3,265	Condenser
40	69	S	18,427	39	0	32	No	16,584	13,820	$365,663	$108,676	$15,727	Condenser
41	69	S	15,240	30	0	0	Yes	762	0	$0	$0	$0	None
42	70	S	21,626	52	0	0	No	19,464	16,220	$470,995	$124,215	$15,316	Condenser
43	71	S	2,156	163	0	0	No	1,940	1,617	$1,370,368	$260,402	$322,117	Condenser
44	72	S	10,423	27	0	7	No	9,380	7,817	$268,433	$94,712	$24,232	Condenser
45	73	S	16,317	161	0	161	No	14,685	12,238	$1,354,163	$256,912	$41,986	Condenser
46	76	S	38,501	110	0	54	No	34,651	28,876	$940,938	$193,347	$13,391	Condenser
47	76	S	128	3	0	0	Yes	6	0	$0	$0	$0	None
48	77	S	32,968	84	0	0	Yes	1,648	0	$0	$0	$0	None
49	78	S	198,460	153	0	153	No	178,614	148,845	$1,289,344	$233,541	$3,138	Condenser
50	78	S	99,117	29	0	0	Yes	4,956	0	$0	$0	$0	None
51	79	S	2,334	8	0	0	No	2,101	1,751	$114,486	$72,257	$82,543	Condenser
52	81	S	122,793	47	0	47	No	110,514	92,095	$430,483	$110,559	$2,401	Condenser
53	84	S	115,383	5	0	5	No	103,845	86,537	$90,179	$60,137	$1,390	Condenser
54	85	S	27,883	23	0	23	No	25,095	20,912	$236,023	$88,547	$8,468	Condenser
55	86	S	90,651	28	0	18	No	81,586	67,988	$276,536	$89,908	$2,645	Condenser
56	88	S	1,724	42	0	41	No	1,551	1,293	$389,970	$113,570	$175,685	Condenser
57	90	S	1,829	3	0	0	No	1,646	1,372	$73,974	$66,226	$96,554	Condenser
58	90	S	9,603	9	0	0	Yes	1,440	0	$0	$0	$0	None
59	94	S	9,478	14	0	2	No	8,530	7,108	$163,101	$79,004	$22,229	Condenser
60	98	S	88,565	75	0	64	No	79,708	66,424	$657,352	$147,111	$4,429	Condenser
61	99	S	35,461	63	0	63	No	31,915	26,596	$560,122	$136,529	$10,267	Condenser
62	102	S	123,753	57	0	57	No	111,378	92,815	$511,507	$122,624	$2,642	Condenser
63	102	S	42,802	16	0	0	Yes	428	0	$0	$0	$0	None
64	103	S	12,749	70	0	70	No	11,474	9,562	$616,839	$146,728	$30,690	Condenser
65	106	S	767,396	14	0	13	No	690,656	575,547	$163,101	$22,160	$77	Condenser
66	107	S	123	13	0	13	No	107	86	$154,999	$78,492	$1,829,863	Condenser
67	112	S	29,943	20	0	15	No	26,948	22,457	$211,716	$84,751	$7,548	Condenser
68	115	S	10,366	68	0	68	No	9,329	7,774	$600,634	$144,480	$37,169	Condenser
69	119	S	4,993	51	0	35	No	4,494	3,745	$462,892	$124,249	$66,362	Condenser
Total			7,493,828					6,398,003	5,255,466	$26,042,999	$6,692,615	$2,547	
National Total			15,861,936					13,542,441	11,124,070	$55,124,348	$14,166,035	$2,547	

ATTACHMENT 3

MACT Floor Emissions and Cost Impacts for Portable Vessels

Coating Mfg. Process Vessels (MACT Floor) – Portable Vessels

	Facility #	Portable or Stationary	Uncontrolled HAP Emissions (lb/yr)	Vessel Count	Cover Count	Condenser Count	MACT	Baseline HAP Emissions (lb/yr)	MACT Floor HAP Reduction (lb/yr)	MACT Floor TCI	MACT Floor TAC ($/yr)	MACT Floor CE ($/ton)	Control Technology
1	4	P	1,843	1	0	0	Yes	1,659	0	$0	$0	$0	None
2	10	P	8,504	44	44	0	No	8,504	850	$196,733	$29,471	$69,314	Cover
3	16	P	8,795	26	0	0	Yes	7,915	0	$0	$0	$0	None
4	29	P	842	4	0	0	Yes	757	0	$0	$0	$0	None
5	39	P	38,306	80	0	0	Yes	34,476	0	$0	$0	$0	None
6	40	P	1,366	8	0	0	Yes	1,230	0	$0	$0	$0	None
7	41	P	1,442	10	0	0	Yes	1,298	0	$0	$0	$0	None
8	42	P	56,970	200	0	0	Yes	51,273	0	$0	$0	$0	None
9	43	P	150,669	179	0	0	Yes	135,602	0	$0	$0	$0	None
10	44	P	20,485	13	0	0	Yes	18,436	0	$0	$0	$0	None
11	50	P	13,731	23	0	0	Yes	12,358	0	$0	$0	$0	None
12	52	P	3,753	70	0	0	Yes	3,378	0	$0	$0	$0	None
13	53	P	4,251	100	0	0	Yes	3,826	0	$0	$0	$0	None
14	56	P	3,024	20	0	0	Yes	2,722	0	$0	$0	$0	None
15	64	P	2,220	4	0	0	Yes	1,998	0	$0	$0	$0	None
16	65	P	7,098	12	0	0	Yes	6,388	0	$0	$0	$0	None
17	66	P	1,828	8	0	0	Yes	1,645	0	$0	$0	$0	None
18	68	P	19,518	27	0	0	Yes	17,566	0	$0	$0	$0	None
19	69	P	1,345	17	0	0	Yes	1,210	0	$0	$0	$0	None
20	70	P	207	1	0	0	Yes	186	0	$0	$0	$0	None
21	71	P	23	4	0	0	Yes	21	0	$0	$0	$0	None
22	72	P	261	2	0	0	Yes	235	0	$0	$0	$0	None
23	73	P	85	5	0	0	Yes	77	0	$0	$0	$0	None
24	76	P	2,773	65	0	0	Yes	2,496	0	$0	$0	$0	None
25	77	P	4,760	82	0	0	Yes	731	0	$0	$0	$0	None
26	78	P	18,330	29	0	0	Yes	16,497	0	$0	$0	$0	None
27	79	P	991	11	0	0	Yes	892	0	$0	$0	$0	None
28	81	P	73,811	87	0	0	Yes	66,430	0	$0	$0	$0	None
29	84	P	28,846	5	0	0	Yes	25,961	0	$0	$0	$0	None
30	85	P	14,205	25	25	0	No	14,205	1,420	$111,780	$16,745	$23,577	Cover
31	86	P	9,689	15	0	0	Yes	8,721	0	$0	$0	$0	None
32	88	P	832	59	0	0	Yes	749	0	$0	$0	$0	None
33	90	P	915	2	0	0	Yes	823	0	$0	$0	$0	None
34	94	P	7,447	12	0	0	Yes	6,702	0	$0	$0	$0	None

Coating Mfg. Process Vessels (MACT Floor) – Portable Vessels (continued)

	Facility #	Portable or Stationary	Uncontrolled HAP Emissions (lb/yr)	Vessel Count	Cover Count	Condenser Count	MACT	Baseline HAP Emissions (lb/yr)	MACT Floor HAP Reduction (lb/yr)	MACT Floor TCI	MACT Floor TAC ($/yr)	MACT Floor CE ($/ton)	Control Technology
35	99	P	401	3	0	0	Yes	361	0	$0	$0	$0	None
36	102	P	108,866	161	0	0	Yes	89,106	0	$0	$0	$0	None
37	103	P	1,023	24	0	0	Yes	921	0	$0	$0	$0	None
38	112	P	3,106	12	0	0	Yes	2,796	0	$0	$0	$0	None
39	115	P	8,604	149	0	0	Yes	7,744	0	$0	$0	$0	None
40	119	P	1,305	46	0	0	Yes	1,174	0	$0	$0	$0	None
Total			632,469					559,068	2,271	$308,513	$46,216	40,704	
National Total			1,338,725					1,183,360	4,807	$653,019	$97,824	40,704	

ATTACHMENT 4

Regulatory Alternative Emissions and Cost Impacts for Portable Vessels

Coating Mfg. Process Vessels (Above Floor) – Portable Vessels

	Facility #	Portable or Stationary	Uncontrolled HAP Emissions (lb/yr)	Vessel Count	Cover Count	Condenser Count	MACT	Baseline HAP Emissions (lb/yr)	Above Floor HAP Reduction (lb/yr)	Above Floor TCI	Above Floor TAC ($/yr)	Above Floor CE ($/ton)	Control Technology
1	4	P	1,843	1	0	0	No	1,659	1,382	$57,769	$63,798	$92,318	Condenser
2	10	P	8,504	44	44	44	No	8,504	6,378	$602,908	$144,960	$45,458	Cover&Condenser
3	16	P	8,795	26	0	6	No	7,915	6,596	$260,331	$93,620	$28,387	Condenser
4	29	P	842	4	0	0	No	757	631	$82,077	$67,514	$213,940	Condenser
5	39	P	38,306	80	0	0	No	34,476	28,730	$697,864	$156,949	$10,926	Condenser
6	40	P	1,366	8	0	0	No	1,230	1,025	$114,486	$72,330	$141,168	Condenser
7	41	P	1,442	10	0	0	No	1,298	1,081	$130,691	$74,751	$138,254	Condenser
8	42	P	56,970	200	0	0	No	51,273	42,727	$1,670,160	$301,199	$14,099	Condenser
9	43	P	150,669	179	0	106	No	135,602	113,002	$1,500,008	$268,683	$4,755	Condenser
10	44	P	20,485	13	0	0	No	18,436	15,364	$154,999	$76,964	$10,019	Condenser
11	50	P	13,731	23	0	0	No	12,358	10,298	$236,023	$89,608	$17,403	Condenser
12	52	P	3,753	70	0	0	No	3,378	2,815	$616,839	$147,403	$104,732	Condenser
13	53	P	4,251	100	0	0	No	3,826	3,189	$859,913	$183,778	$115,275	Condenser
14	56	P	3,024	20	0	0	No	2,722	2,268	$211,716	$86,770	$76,516	Condenser
15	64	P	2,220	4	0	3	No	1,998	1,665	$82,077	$67,411	$80,972	Condenser
16	65	P	7,098	12	0	0	No	6,388	5,323	$146,896	$76,755	$28,838	Condenser
17	66	P	1,828	8	0	0	No	1,645	1,371	$114,486	$72,295	$105,467	Condenser
18	68	P	19,518	27	0	0	No	17,566	14,638	$268,433	$94,029	$12,847	Condenser
19	69	P	1,345	17	0	0	No	1,210	1,009	$187,409	$83,255	$165,104	Condenser
20	70	P	207	1	0	0	No	186	155	$57,769	$63,920	$824,955	Condenser
21	71	P	23	4	0	0	No	21	17	$82,077	$67,575	$7,907,645	Condenser
22	72	P	261	2	0	0	No	235	195	$65,872	$65,130	$666,550	Condenser
23	73	P	85	5	0	0	No	77	64	$90,179	$68,784	$2,152,303	Condenser
24	76	P	2,773	65	0	0	No	2,496	2,080	$576,327	$141,408	$135,962	Condenser
25	77	P	580	10	0	10	No	522	435	$130,691	$74,816	$343,729	Condenser
26	77	P	4,179	72	0	0	Yes	209	0	$0	$0	$0	None
27	78	P	18,330	29	0	29	No	16,497	13,747	$284,638	$96,546	$14,046	Condenser
28	79	P	991	11	0	0	No	892	743	$138,794	$75,999	$204,504	Condenser
29	81	P	73,811	87	0	0	No	66,430	55,359	$754,581	$162,782	$5,881	Condenser
30	84	P	28,846	5	0	0	No	25,961	21,634	$90,179	$66,627	$6,159	Condenser
31	85	P	14,205	25	25	25	No	14,205	10,654	$364,008	$108,745	$20,415	Cover&Condenser
32	86	P	9,689	15	0	0	No	8,721	7,267	$171,204	$80,202	$22,073	Condenser
33	88	P	832	59	0	0	No	749	624	$527,712	$134,271	$430,171	Condenser
34	90	P	915	2	0	0	No	823	686	$65,872	$65,081	$189,770	Condenser

Coating Mfg. Process Vessels (Above Floor) – Portable Vessels (continued)

	Facility #	Portable or Stationary	Uncontrolled HAP Emissions (lb/yr)	Vessel Count	Cover Count	Condenser Count	MACT	Baseline HAP Emissions (lb/yr)	Above Floor HAP Reduction (lb/yr)	Above Floor TCI	Above Floor TAC ($/yr)	Above Floor CE ($/ton)	Control Technology
35	94	P	7,447	12	0	5	No	6,702	5,585	$146,896	$76,729	$27,477	Condenser
36	99	P	401	3	0	0	No	361	301	$73,974	$66,333	$440,625	Condenser
37	102	P	98,896	146	0	146	No	89,007	74,172	$1,232,627	$232,512	$6,270	Condenser
38	102	P	9,969	15	0	0	Yes	100	0	$0	$0	$0	None
39	103	P	1,023	24	0	0	No	921	768	$244,126	$91,775	$239,151	Condenser
40	112	p	3,106	12	0	0	No	2,796	2,330	$146,896	$77,054	$66,146	Condenser
41	115	P	8,604	149	0	54	No	7,744	6,453	$1,256,934	$242,925	$75,287	Condenser
42	119	P	1,305	46	0	0	No	1,174	979	$422,380	$118,457	$242,106	Condenser
Total			632,469					559,068	463,740	$14,918,821	$4,399,743	$18,975	
National Total			1,338,725					1,183,360	981,583	$31,578,171	$9,312,789	$18,975	

ATTACHMENT 5

Cover Cost Information

CONTACT REPORT

From: Chuck Zukor

Date of Contact: July 20, 1999

Contacted by: Telephone

Company/Agency: Alpha-Gamma Technologies, Inc.

Telephone Number:

Person(s) Contacted/Title(s)

Bev Brown, KARG Corporation

CONTACT SUMMARY

Subject: Costs to Manufacture a Stainless Steel Cover

Construction cost estimate for a stainless steel cover for an uncovered process vessel. Contacted Ms. Bev Brown of the KARG Corporation. She has 20+ years of experience in estimating costs for steel fabrication projects.

Assumptions:
- Cover diameter = 10 feet
- Material of construction is 304 stainless steel
- Cover cut out of plate stainless steel using plasma jets
- Cover is a two-piece construction hinged to a tilt open by more than 270 degrees

Item	Quantity	Cost
Plasma cut cover from plate stainless steel	2 ($900 * 2)	$1,800
Steel rolling	2 ($400 * 2)	$800
Welding	1	$400
Ring flange (a perimeter lip)	1	$300
Hinges	1	$200
Gasketing, etc.	1	$100
	Total	$3,600 per cover

ATTACHMENT 6

OAQPS Spreadsheet for MACT Floor Refrigerated Condenser

Custom Refrigerated Condenser at 60% Removal

TOTAL ANNUAL COST SPREADSHEET PROGRAM--REFRIGERATION/CUSTOM [1]

COST BASE DATE: Third Quarter 1990 [2]

VAPCCI (Third Quarter 1990--FINAL:	103.3
VAPCCI (First Quarter 1994--FINAL:	100.0
VAPCCI (First Quarter 1999--FINAL: [3]	106.1

INPUT PARAMETERS:

-- Inlet stream flowrate (scfm):	100
-- Inlet stream temperature (oF):	77
-- VOC to be condensed:	Toluene
-- VOC inlet volume fraction:	0.040
-- Required VOC removal (fraction):	0.600
-- Antoine equation constants for VOC: [4]	
A:	6.955
B:	1344.800
C:	219.480
-- VOC heat of condensation (BTU/lb-mole):	14270
-- VOC heat capacity (BTU/lb-mole-oF):	24.770
-- Coolant specific heat (BTU/lb-oF):	0.650
-- VOC boiling point (oF):	231
-- VOC critical temperature (oR):	1065
-- VOC molecular weight (lb/lb-mole):	92
-- VOC condensate density (lb/gal):	7.20
-- Air heat capacity (BTU/lb-mole-oF):	6.95

DESIGN PARAMETERS:

-- Outlet VOC partial pressure (mm Hg):	12.46
-- Condensation temperature, Tc (oF):	50.0
-- VOC flowrate in (lb-moles/hr):	0.6122
-- VOC flowrate out (lb-moles/hr):	0.24490
-- VOC condensed (lb-moles/hr):	0.3673
(lb/hr):	33.8
-- VOC heat of condensation @ Tc (BTU/lb-mole):	16579
-- Enthalpy change, condensed VOC (BTU/hr):	6335
-- Enthalpy change, uncondensed VOC (BTU/hr):	163
-- Enthalpy change, air (BTU/hr):	2752
-- Condenser heat load (BTU/hr):	9251
-- Heat transfer coefficient, U (BTU/hr-ft2-oF):	20
-- Log-mean temperature difference (oF):	16.0
-- Condenser surface area (ft2):	29.0
-- Coolant flowrate (lb/hr):	569
-- Refrigeration capacity (tons):	0.77
-- Electricity requirement (kW/ton):	1.3

CAPITAL COSTS

Equipment Costs ($):	
-- Refrigeration unit/single-stage (< 10 tons):	8,441
-- Refrigeration unit/single-stage (> 10 tons):	0
-- Multistage refrigeration unit:	0
-- VOC condenser:	4,761
-- Recovery tank:	2,062
-- Auxiliaries (ductwork, etc.):	0
Total equipment cost ($)--base:	15,264
' ' ' ' --escalated:	15,568
Purchased Equipment Cost ($):	18,370
Total Capital Investment ($):	31,964

ANNUAL COST INPUTS:

Operating factor (hr/yr):	8760
Operating labor rate ($/hr):	15.64
Maintenance labor rate ($/hr):	17.20
Operating labor factor (hr/sh):	0.25

Maintenance labor factor (hr/sh):	0.50
Electricity price ($/kWhr):	0.0590
Recovered VOC value ($/lb):	0.10
Annual interest rate (fraction):	0.07
Control system life (years):	15
Capital recovery factor:	0.1098
Taxes, insurance, admin. factor:	0.04

ANNUAL COSTS:

Item	Cost ($/yr)	Wt. Factor	W.F.(cond.)
Operating labor	4,281	0.099	----
Supervisory labor	642	0.015	----
Maintenance labor	9,419	0.217	----
Maintenance materials	9,419	0.217	----
Electricity	609	0.014	----
Overhead	14,257	0.328	0.876
Taxes, insurance, administrative	1,279	0.029	----
Capital recovery	3,510	0.081	0.110
Total Annual Cost (without credits)	43,417	1.000	1.000
Recovery credits	(29,650)		
Total Annual Cost (with credits)	13,766		

NOTES:

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[1] Data used to develop this spreadsheet were taken from Chapter 8 of the OAQPS CONTROL COST MANUAL (5th edition).

[2] Base equipment costs reflect this date.

[3] VAPCCI = Vatavuk Air Pollution Control Cost Index (for refrigeration systems) corresponding to year and quarter shown. Base equipment cost, purchased equipment cost, and total capital investment have been escalated to this date via the VAPCCI and control equipment vendor data.

[4] See MANUAL, Table 8.8, for list of Antoine constants.

Electricity Requirement (kW/ton) vs. Condensation Temperature (oF)

-100	11.7
-50	5
-20	4.7
20	2.2
40	1.3

ATTACHMENT 7

OAQPS Spreadsheet for Above the Floor Refrigerated Condenser

Custom Refrigerated Condenser at 75% Removal

TOTAL ANNUAL COST SPREADSHEET PROGRAM--REFRIGERATION/CUSTOM [1]

COST BASE DATE: Third Quarter 1990 [2]

VAPCCI (Third Quarter 1990--FINAL:	103.3
VAPCCI (First Quarter 1994--FINAL:	100.0
VAPCCI (First Quarter 1999--FINAL: [3]	106.1

INPUT PARAMETERS:

-- Inlet stream flowrate (scfm):	100
-- Inlet stream temperature (oF):	77
-- VOC to be condensed:	Toluene
-- VOC inlet volume fraction:	0.0400
-- Required VOC removal (fraction):	0.750
-- Antoine equation constants for VOC: [4]	
A:	6.955
B:	1344.800
C:	219.480
-- VOC heat of condensation (BTU/lb-mole):	14270
-- VOC heat capacity (BTU/lb-mole-oF):	24.770
-- Coolant specific heat (BTU/lb-oF):	0.650
-- VOC boiling point (oF):	231
-- VOC critical temperature (oR):	1065
-- VOC molecular weight (lb/lb-mole):	92
-- VOC condensate density (lb/gal):	7.20
-- Air heat capacity (BTU/lb-mole-oF):	6.95

DESIGN PARAMETERS:

-- Outlet VOC partial pressure (mm Hg):	7.84
-- Condensation temperature, Tc (oF):	36.3
-- VOC flowrate in (lb-moles/hr):	0.6122
-- VOC flowrate out (lb-moles/hr):	0.15306
-- VOC condensed (lb-moles/hr):	0.4592
(lb/hr):	42.3
-- VOC heat of condensation @ Tc (BTU/lb-mole):	16733
-- Enthalpy change, condensed VOC (BTU/hr):	8146
-- Enthalpy change, uncondensed VOC (BTU/hr):	154
-- Enthalpy change, air (BTU/hr):	4155
-- Condenser heat load (BTU/hr):	12455
-- Heat transfer coefficient, U (BTU/hr-ft2-oF):	20
-- Log-mean temperature difference (oF):	21.9
-- Condenser surface area (ft2):	28.4
-- Coolant flowrate (lb/hr):	766
-- Refrigeration capacity (tons):	1.04
-- Electricity requirement (kW/ton):	2.2

CAPITAL COSTS

Equipment Costs ($):	
-- Refrigeration unit/single-stage (< 10 tons):	11,319
-- Refrigeration unit/single-stage (> 10 tons):	0
-- Multistage refrigeration unit:	0
-- VOC condenser:	4,741
-- Recovery tank:	2,088
-- Auxiliaries (ductwork, etc.):	0
Total equipment cost ($)--base:	18,148
' ' ' ' --escalated:	18,509
Purchased Equipment Cost ($):	21,841
Total Capital Investment ($):	38,003

ANNUAL COST INPUTS:

Operating factor (hr/yr):	8760
Operating labor rate ($/hr):	15.64
Maintenance labor rate ($/hr):	17.20
Operating labor factor (hr/sh):	0.25
Maintenance labor factor (hr/sh):	0.50
Electricity price ($/kWhr):	0.0590
Recovered VOC value ($/lb):	0.10
Annual interest rate (fraction):	0.07
Control system life (years):	15
Capital recovery factor:	0.1098
Taxes, insurance, admin. factor:	0.04

ANNUAL COSTS:

Item	Cost ($/yr)	Wt. Factor	W.F.(cond.)
Operating labor	4,281	0.095	----
Supervisory labor	642	0.014	----
Maintenance labor	9,419	0.209	----
Maintenance materials	9,419	0.209	----
Electricity	1,388	0.031	----
Overhead	14,257	0.316	0.843
Taxes, insurance, administrative	1,520	0.034	----
Capital recovery	4,173	0.093	0.126
Total Annual Cost (without credits)	45,100	1.000	1.000
Recovery credits	(37,063)		
Total Annual Cost (with credits)	8,038		

NOTES:

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[1] Data used to develop this spreadsheet were taken from Chapter 8 of the OAQPS CONTROL COST MANUAL (5th edition).

[2] Base equipment costs reflect this date.

[3] VAPCCI = Vatavuk Air Pollution Control Cost Index (for refrigeration systems) corresponding to year and quarter shown. Base equipment cost, purchased equipment cost, and total capital investment have been escalated to this date via the VAPCCI and control equipment vendor data.

[4] See MANUAL, Table 8.8, for list of Antoine constants.

Electricity Requirement (kW/ton) vs. Condensation Temperature (oF)

-100	11.7
-50	5
-20	4.7
20	2.2
40	1.3

MRI

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Date: March 8, 2000
(revised October 27, 2000 and September 30, 2001)

Subject: MACT Floor, Regulatory Alternatives, and Nationwide Impacts for Transfer Operations at Coatings Manufacturing Facilities
Miscellaneous Organic NESHAP
EPA Project No. 95/08; MRI Project No. 104803.1.049

From: Brenda Shine, North State Engineering
David Randall

To: MON Project File

I. Introduction

This memorandum describes existing and new source MACT floors and regulatory alternatives for transfer operations at coating manufacturing facilities. This memorandum also presents the resulting emission reductions and costs for the regulatory alternatives.

II. MACT Floor and Regulatory Alternatives

In the data gathering effort for this project, no data were requested regarding transfer operations. Therefore, the project team relied on other available information to set the MACT floors. The following paragraphs describe this effort.

A. Existing Source MACT Floor

In the absence of industry-specific data, the approach used to set the floor was to review existing requirements and determine the level of control presumed to exist for transfer operations. As part of the development of the Organic Liquids Distribution MACT, existing state rules were reviewed to determine what the minimum level of control was for transfer operations.[1] Generally, state rules require 90 percent control of operations where greater than 20,000 gallons per day (7.3 million gallons/yr) of VOC having vapor pressures of 1.5 psia or more are transferred. However, this requirement is typically applied to transport vessels such as tank trucks and railcars. For other containers, such as totes and drums, these regulations typically do not apply.

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[1]Presumptive MACT for Organic Liquids (Non-Gasoline) Distribution Facilities. USEPA, June 9, 1998.

Transfer operations in this industry result from the loading of transport vessels as well as other containers, although we believe that the majority of loading is into containers other than trucks and railcars. Since there are no existing regulations that apply to the loading of these containers, we are not establishing a MACT floor for existing sources.

B. New Source MACT Floor

For new sources, we conducted a telephone survey of facilities identified in the database to have high HAP throughput, based on the section 114 survey responses for storage tanks. We were unable to identify any facilities that control emissions from bulk loading operations. Because we did not identify any means by which facilities are controlling emissions from such operations, we are not establishing a new source MACT floor for transfer operations.

C. Cost Effectiveness and Selection of Regulatory Alternatives

In order to select a reasonable regulatory alternative above the floor, we first developed a cost model to estimate the cost effectiveness of controlling loading operations. The model is based on controlling displaced emissions from bulk loading operations using the same condenser developed for the analysis to estimate the cost to control emissions from process vessels. Emissions from bulk loading exhibit the same characteristics as emissions from the transfer of materials in process vessels (i.e., they result from displacement of gases during filling and are assumed to be saturated emission streams that can be effectively controlled using condensers). The cost model was used to identify what amount of material throughput at various partial pressures would result in a reasonable cost effectiveness. We examined coatings with four individual HAP (toluene, xylene, methanol, and methyl ethyl ketone) and a generic mix of HAP. The results of this analysis are provided in Table 1, and an example algorithm is in Attachment 1. The following assumptions and procedures were used in the analysis:

- The reported annual HAP usage is equal to the amount of HAP in product coatings.
- Coatings have 1.75 lb HAP/gal of coating; the remainder is assumed to be solids.
- Loading flow is 30 gal/min.
- Displaced vapors are saturated with HAP at 25EC.
- The specific gravity of the generic mix of HAP compounds is 0.8 and its molecular weight is 80.
- Additional loading stations are added for each 15.77 million gal of coating.
- Capital costs estimated for 500 ft of 2-inch schedule 40 steel pipe, one condenser with surface area of 38 ft^2, and one 500-gal waste storage tank (regardless of the number of loading stations).

C A condenser surface area of 38 ft^3 is the smallest size for which the OAQPS costing equation is applicable, but the required sizes are typically about an order of magnitude smaller.[2]

C The same type of piping is used for coolant, the emission stream, and condensate; and the cost is $3.26/ft.

C The waste solvent tank cost is based on an OAQPS equation for 316 stainless steel vertical tanks.[2]

C Required control efficiency is 75 percent, as in the analysis for process vessels.[3] Thus, condenser outlet temperatures range from 34EF for toluene to 39EF for xylene.

C Waste disposal costs are $1/lb of condensed HAP.

C No operator labor.

C Maintenance labor costs based on 0.2 hr/shift, $17.20/hr, and the condenser operating hours.

C For one loading station, condenser operating hours equal the hours required to load all of the coating at 30 gal/min. For multiple loading stations, condenser operating hours assumed to be 8,500 hr/yr (i.e., at least one station operating almost all the time).

C Maintenance materials costs equal to the maintenance labor costs.

C Electricity costs estimated based on the increase in refrigeration capacity needed to handle the emission stream from the transfer operation, $0.059/kwh, the average operating hours per loading station, and the number of loading stations.

C Overhead equal to 60 percent of the sum of the maintenance labor and materials costs.

C Property taxes, insurance, and administrative charges equal to 4 percent of the capital investment.

C Capital recovery factor of 0.1098 (15 year life and 7 percent interest).

From Table 1, we found the cost to be reasonable for controlling emissions from the transfer of coatings if the HAP throughput and partial pressure were above certain levels. We recommend that applicability thresholds for the regulatory alternative above the floor for both new and existing sources be a HAP throughput of $3.0 million gal/yr and a HAP partial pressure of $1.5 psia. Based on the results for the generic HAP mix, the throughput cutoff could have

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[2]OAQPS Control Cost Manual. Fourth Edition. EPA 450/3-90-006. January 1990. Chapter 8.

[3]Memorandum from D. Randall and D. Lincoln, MRI, to Project File. March 8, 2000. MACT floor, regulatory alternatives, and nationwide impacts for process vessels at coatings manufacturing facilities.

been lower. However, 3.0 million gal/yr is a conservative cutoff that ensures control is cost effective for transfer of coatings containing any individual HAP with a partial pressure $1.5 psia. We also considered adding a second set of thresholds with a higher throughput and a lower partial pressure as part of the regulatory alternative. However, available information indicates that no existing facilities would meet any such combination of cost effective cutoffs. The regulatory alternative is summarized in Table 2.

TABLE 1. CALCULATION OF COST EFFECTIVENESS

Solvent throughput, gal/yr	Coating throughput, gal/yr	HAP Solvent	HAP partial pressure, psia	Number of loading stations	Condenser operating hours, hr/yr	Emissions reduction, Mg/yr	Total annual cost, $/yr	Cost effectiveness, $/Mg
6,000,000	24,760,000	Xylene	0.13	2	8,500	2.65	19,438	7,346
3,000,000	10,305,000	Toluene	0.5	1	6,870	4.94	22,338	4,523
5,000,000	20,610,000	Toluene	0.5	2	8,500	8.23	31,779	3,861
6,000,000	24,730,000	Toluene	0.5	2	8,500	9.88	35,423	3,586
9,000,000	37,100,000	Toluene	0.5	3	8,500	14.8	46,353	3,129
3,000,000	11,500,000	MEK	1.7	1	6,386	11.4	35,794	3,150
6,000,000	23,000,000	MEK	1.7	2	8,500	22.7	63,845	2,809
2,500,000	9,420,000	Methanol	2.4	1	5,236	5.70	21,721	3,814
4,000,000	15,100,000	Methanol	2.4	1	8,378	9.11	33,721	3,700
5,000,000	18,850,000	Methanol	2.4	2	8,500	11.4	38,865	3,412
2,000,000	7,616,000	Generic	1	1	4,231	4.81	18,362	3,815
4,000,000	15,232,000	Generic	1	1	8,462	9.63	34,861	3,621
6,000,000	22,848,000	Generic	1	2	8,500	14.4	45,590	3,157
1,000,000	3,808,000	Generic	1.5	1	2,116	3.61	12,766	3,536
2,000,000	7,616,000	Generic	1.5	1	4,231	7.22	23,668	3,278
3,000,000	11,424,000	Generic	1.5	1	6,347	10.8	34,571	3,192

TABLE 2. SUMMARY OF REGULATORY ALTERNATIVES

Regulatory Alternative	Existing Source	New Sources
MACT Floor	None	None
Regulatory Alternative	Control emissions by $75 percent from transfer of coatings with total HAP content $3 MM gal/yr and HAP partial pressure $1.5 psia	Control emissions by $75 percent from transfer of coatings with total HAP content $3 MM gal/yr and HAP partial pressure $1.5 psia

III. Impacts

Impacts for the coatings source category were evaluated using data collected from the coatings industry. Although we did not have data on transfer operations, we estimated the throughput based on the total storage tank throughput of solvent reported at the facility. Only the W.M. Barr and Company facility in Memphis, Tennessee was estimated to have a yearly throughput and partial pressure high enough to trigger applicability at the regulatory alternative level, assuming the throughput is all for bulk loading operations. The estimated impacts of controlling this particular facility are presented in Table 3.

TABLE 3. IMPACTS FOR TRANSFER OPERATIONS AT EXISTING SOURCES

Solvent throughput, gal/yr	Estimated coating throughput, gal/yr[a]	HAP solvent	HAP partial pressure, psia	Estimated number of loading stations	Condenser operating hours, hr/yr	Emission reductions, Mg/yr[c]	Total annual cost, $/yr[d]	Cost effectiveness, $/Mg
3,143,000	14,960,000	mix[b]	3.93	1	8,311	37.2	95,352	2,566

[a] Coatings throughput estimated assuming the HAP content is 1.75 lb HAP/gal of coating (and the remainder of the coatings are solids). Also, the specific gravity of the mix of HAP at the facility was determined to be 1.

[b] Mix of methylene chloride, methanol, methyl ethyl ketone, toluene, and xylene.

[c] Estimated assuming displaced vapors are saturated and controlled to 75 percent.

[d] Estimated using same procedures described above for setting the MACT floor applicability thresholds.

IV. Conclusions

The MACT floor for transfer operations from coatings facilities is based on existing regulations for transfer of VOCs. Although there are limited data available to suggest that there are a significant number of facilities with a throughput of material with HAP partial pressure in the range of that described in the regulatory alternative, the cost of the alternative appears to be reasonable.

Attachment 1

Summary of Impacts and Example Algorithm

Calculation of Vent Flowrate

		Temperature, C	25					
Antoine Coefficients		MW	SG	a	b	c	VP (mmHg)	mol fraction
	toluene	92	0.866	6.955	1344.8	219.48	28.46725	0.03746
	xylene	106	0.867	6.999	1474.7	213.7	6.621437	0.00871
	methanol	32	0.792	7.897	1474.08	229	124.0325	0.1632
	mek	72	0.805	6.9742	1209.6	216	90.18055	0.11866
	Generic	80	0.8					

Assume 1.75 lb HAP/gal coating

Solvent throughput (gal/yr)	Estimated coating throughput gal/yr	Solvent	VP psia (25C)	Loading Rate (gpm)	No. of stations	Avg. op hr/yr/ station	Control operation (hrs/yr)	Emissions reductions Mg/yr	TAC ($/yr)	Cost Effectiveness ($/Mg)
3,000,000	12,366,480	Toluene	0.5	30	1		6,870	4.9386524	22,338	4,523
2,500,000	10,305,400	Toluene	0.5	30	1		5,725	4.1155436	18,851	4,580
5,000,000	20,610,800	Toluene	0.5	30	2		8,500	8.2310873	31,779	3,861
6,000,000	24,732,960	Toluene	0.5	30	2		8,500	9.8773047	35,423	3,586
9,000,000	37,099,440	Toluene	0.5	30	3		8,500	14.815957	46,353	3,129
3,000,000	12,380,760	Xylene	0.13	30	1		6,878	1.3230432	14,307	10,814
6,000,000	24,761,520	Xylene	0.13	30	2		8,500	2.6460863	19,438	7,346
2,500,000	9,424,800	methanol	2.4	30	1		5,236	5.6954252	21,721	3,814
4,000,000	15,079,680	methanol	2.4	30	1		8,378	9.1126803	33,721	3,700
5,000,000	18,849,600	methanol	2.4	30	2		8,500	11.39085	38,865	3,412
9,000,000	33,929,280	methanol	2.4	30	3		8,500	17.086276	51,516	3,015
3,000,000	11,495,400	mek	1.7	30	1		6,386	11.364178	35,794	3,150
4,000,000	15,327,200	mek	1.7	30	1		8,515	15.152238	47,084	3,107
6,000,000	22,990,800	mek	1.7	30	2		8,500	22.728357	63,845	2,809
9,000,000	34,486,200	mek	1.7	30	3		8,500	34.092535	88,987	2,610
2,000,000	7,616,000	generic	1	30	1	4,231	4,231	4.81368	18,362	3,815
4,000,000	15,232,000	generic	1	30	1	8,462	8,462	9.62737	34,861	3,621
6,000,000	22,848,000	generic	1	30	2	6,347	8,500	14.44105	45,590	3,157
1,000,000	3,808,000	generic	1.5	30	1	2,116	2,116	3.61026	12,766	3,536
2,000,000	7,616,000	generic	1.5	30	1	4,231	4,231	7.22053	23,668	3,278
3,000,000	11,424,000	generic	1.5	30	1	6,347	6,347	10.83079	34,571	3,192
Fac. 108	SG=1									
3,142,932	14,960,356	mix	3.93	30	1	8,311	8,311	37.16080	95,352	2,566

The TAC for facility 108 and facilities using coatings with generic solvents include:

1. TCI * 0.1498
2. maintenance labor based on total control operating hours
3. electricity cost based on estimated maximum increase in refrigeration capacity (see MeOH worksheet), average operating hr/yr per station, and the number of stations
4. waste disposal based on 75 percent control

TOTAL ANNUAL COST SPREADSHEET PROGRAM--REFRIGERATION/PACKAGE [1]

COST BASE DATE: Third Quarter 1990 [2]

VAPCCI (First Quarter 1999): [3] 116.4

INPUT PARAMETERS:		
-- Inlet stream flowrate (scfm):		4
-- Number of loading stations		2
-- Inlet stream temperature (oF):		77
-- VOC to be condensed:		Methanol
-- VOC inlet volume fraction:		0.1632
-- Required VOC removal (fraction):		0.750
-- Antoine equation constants for VOC:		
	A:	7.897
	B:	1474.080
	C:	229.130
-- VOC heat of condensation (BTU/lb-mole):		14830
-- VOC heat capacity (BTU/lb-mole-oF):		10.490
-- Coolant specific heat (BTU/lb-oF):		0.650
-- VOC boiling point (oF):		148
-- VOC critical temperature (oR):		923
-- VOC molecular weight (lb/lb-mole):		32.00
-- VOC condensate density (lb/gal):		7.20
-- Air heat capacity (BTU/lb-mole-oF):		6.95
DESIGN PARAMETERS:		
-- Outlet VOC partial pressure (mm Hg):		35.33
-- Condensation temperature, Tc (oF):		37.5
-- VOC flowrate in (lb-moles/hr):		0.0999
-- VOC flowrate out (lb-moles/hr):		0.0250
-- VOC condensed (lb-moles/hr):		0.0749
(lb/hr):		2.4
-- VOC heat of condensation @ Tc (BTU/lb-mole):		16625
-- Enthalpy change, condensed VOC (BTU/hr):		1277
-- Enthalpy change, uncondensed VOC (BTU/hr):		10
-- Enthalpy change, air (BTU/hr):		141
-- Condenser heat load (BTU/hr):		1428
-- Heat transfer coefficient, U (BTU/hr-ft2-oF):		20
-- Log-mean temperature difference (oF):		20.5
-- Condenser surface area (ft2):		3.5
-- Coolant flowrate (lb/hr):		88
-- Refrigeration capacity (tons):	0.71 min@20oF	0.12
CAPITAL COSTS		
Equipment Costs ($):		
-- Waste Solvent Tank (500 gallons)		3,320
-- Heat Exchanger		5,067
-- Piping		1,305
Total equipment cost ($)--base:		9,692
' ' ' ' --escalated:		10,016
Purchased Equipment Cost ($):		10,817
Total Capital Investment ($):		12,439

ANNUAL COST INPUTS:

Operating factor (for labor), hr/yr	8500	
Avg operating factor/station, hr/yr	5236	Change reference as necessary
Operating labor rate ($/hr):	$15.64	
Maintenance labor rate ($/hr):	$17.20	
Operating labor factor (hr/sh):	0.0000	
Maintenance labor factor (hr/sh):	0.2000	
Electricity price ($/kWhr):	0.0590	
Haz Waste Disposal Cost ($/lb):	1.0000	
Annual interest rate (fraction):	0.0700	
Control system life (years):	15	
Capital recovery factor:	0.1098	
Taxes, insurance, admin. factor:	0.0400	

ANNUAL COSTS:

Item	Cost ($/yr)	Wt. Factor	W.F.(cond.)
Operating labor	0	0.000	----
Supervisory labor	0	0.000	----
Maintenance labor	3,656	0.266	----
Maintenance materials	3,656	0.266	----
Electricity	190	0.014	----
Overhead	4,387	0.319	0.851
Taxes, insurance, administrative	498	0.036	----
Capital recovery	1,366	0.099	0.135
Total Annual Cost (without waste disposal)	13,752	1.000	1.000
Waste Disposal	25,112		
Total Annual Cost (with waste disposal)	38,865		

NOTES:

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[1] Data used to develop this spreadsheet were taken from Chapter 8 of the OAQPS CONTROL COST MANUAL (4th edition).

[2] Base equipment costs reflect this date.

[3] VAPCCI = Vatavuk Air Pollution Control Cost Index (for refrigeration systems) corresponding to year and quarter shown. Base equipment cost, purchased equipment cost, and total capital investment have been escalated to this date via the VAPCCI and control equipment vendor data.

MRI

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Date: March 13, 2000
(Revised September 15, 2000)

Subject: MACT Floor, Regulatory Alternatives, and Nationwide Impacts for Equipment Leaks at Coatings Manufacturing Facilities
Miscellaneous Organic NESHAP
EPA Project No. 95/08; MRI Project No. 104803.1.049

From: David Randall

To: MON Project File

I. Introduction

This memorandum describes existing and new source MACT floors and regulatory alternatives for equipment leaks at coating manufacturing facilities. This memorandum also presents the resulting emission reductions and costs for the regulatory alternatives.

II. MACT Floor and Regulatory Alternatives

The MACT floor for both existing and new sources is a sensory program equivalent to that in the bulk gasoline terminal NESHAP.[1,2] A regulatory alternative more stringent than the MACT floor was developed for both existing and new sources; this alternative is a leak detection and repair (LDAR) program equivalent to that in the hazardous organic NESHAP (HON).

III. Impacts

The HAP emission reductions and cost impacts associated with the MACT floor and regulatory alternative were first estimated for four model facilities. The model facilities consisted of 25, 50, 100, and 200 process vessels. Each group of 25 process vessels was assumed to have the following mix of components:

- 30 valves in light liquid service
- 6 pumps in light liquid service
- 100 flanges
- 2 open-ended lines
- 2 sampling connections

The procedures used to estimate the emissions, emission reductions, and cost impacts are described in the following sections of this memorandum. The results of the analyses for each existing coatings facility to meet the MACT floor and the regulatory alternative are presented in Attachments 1 and 2, respectively, and are summarized in Table 1.

TABLE 1. IMPACTS OF REGULATORY ALTERNATIVES FOR EXISTING SOURCES

Regulatory alternative	Emission reduction, Mg/yr	Total capital investment, $	Total annual cost, $/yr	Cost effectiveness, $/Mg	
				Relative to baseline	Incremental
MACT floor	234	636,000	396,000	1,690	N/A
Regulatory alternative	598	845,000	1,390,000	2,320	2,700

A. Emissions Estimates

Equipment leak HAP emissions were estimated using the same emission factors that were developed for the MON chemical manufacturing processes. These factors are based on data from 2 of the 3 types of processes that were used to develop the average SOCMI emission factors. The three processes are cumene, vinyl acetate, and ethylene. The MON factors were developed as the average of the factors for cumene and vinyl acetate. Ethylene data were excluded because ethylene units have many components in gas-phase and high pressure liquid phase service, which differ from the characteristics of MON chemical processes. Uncontrolled emission factors were developed from the original data. Emission factors for the MACT floor and the regulatory alternative were estimated using the Monitoring and Maintenance for Equipment Leaks (MAMEL) model.[3] In the MAMEL model, the MACT floor factors were developed for the LDAR program required in 40 CFR part 60, subpart VV. The resulting factors for the smallest model facility are 4.03 tons/yr for an uncontrolled facility, 2.87 tons/yr for a facility implementing the MACT floor program, and 1.56 tons/yr for a facility implementing the regulatory alternative. Attachment 3 shows how these values were calculated for the smallest model facility.

For each existing facility, uncontrolled emissions were estimated by multiplying 4.03 tons/yr by the actual number of process vessels at the facility and dividing by 25 (the number of model process vessels). For the majority of the facilities, these emissions are also the baseline emissions. However, for the 40 facilities that are implementing an LDAR program equivalent to the MACT floor, the baseline emissions were estimated by multiplying 2.87 tons/yr by the ratio of actual to model process vessels. Emission reductions for the MACT floor were estimated by multiplying the difference between the baseline and MACT floor factors by the ratio of actual to model processes. Emission reductions for the regulatory alternative were estimated by multiplying the difference between the baseline and regulatory alternative factors by the ratio of actual to model processes.

The nationwide uncontrolled emissions were estimated to be 1,231 tons/yr (1,117 Mg/yr), and the nationwide baseline emissions were estimated to be 1,135 tons/yr (1,030 Mg/yr). Emission reductions under the MACT floor and regulatory alternative are shown in Table 1.

B. Cost Impacts

The cost impacts consist of both initial costs and annual costs. All of the following initial costs were treated as part of the total capital investment (TCI):

- initial control equipment (gate valve for open-ended lines, closed purge system for sampling connections)
- data collection system
- initial planning and training
- initial data entry for sensory program

The total annual cost (TAC) consists of all of the following:

- annual monitoring costs (for pumps, valves, and connectors)
- annual maintenance cost (for pumps, open-ended lines, and sampling connections)
- annual online repair costs (for all leaking pumps and some leaking valves and connectors)
- annual offline repair costs (for the remainder of the valves and connectors)
- annual miscellaneous costs (for pumps, open-ended lines, and the data collection system)
- annual monitoring instrument rental cost (for the regulatory alternative only)
- annual administrative and reporting costs (for the regulatory alternative only)

The TCI and TAC were estimated using procedures nearly identical to those used to estimate costs for the Amino and Phenolic Resins NESHAP (and the HON before that).[4] The data and equations used to estimate the costs for the 4 model facilities are presented in Attachment 4. Examples of the spreadsheets used to estimate the MACT floor and regulatory alternative costs for the smallest model facility are presented in Attachment 5. The resulting MACT floor and regulatory alternative costs for all 4 model facilities are summarized in Table 2. These data were plotted, and linear regression was used to determine the following equations for the lines through the TCI and TAC data:

$$\text{MACT Floor TCI} = 67.8 \times \text{Total vessels} + 2{,}974$$

$$\text{MACT Floor TAC} = 63.778 \times \text{Total vessels} + 470.3$$

TABLE 2. EMISSION REDUCTIONS AND COSTS FOR MODEL FACILITIES

Parameter	Model facility			
	A	B	C	D
Number of process vessels	25	50	100	200
Emission reduction, tons/yr				
MACT floor	1.16	2.32	4.64	9.28
Regulatory alternative	2.47	4.94	9.88	19.76
Total capital investment, $				
MACT floor	4,668	6,363	9,753	15,532
Regulatory alternative	6,476	8,057	11,220	17,544
Total annual cost, $/yr				
MACT floor	2,065	3,659	6,848	13,226
Regulatory alternative	8,321	11,027	16,439	27,264

$$\text{Reg Alt TCI} = 63.2 \times \text{Total vessels} + 4{,}895$$

$$\text{Reg Alt TAC} = 108.25 \times \text{Total vessels} + 5{,}614.7$$

The above equations were used to estimate the MACT floor and regulatory alternatives cost impacts for each of the coatings facilities. The results for each facility are presented in Attachments 1 and 2, and the nationwide totals are presented in Table 1.

IV. References

1. Memorandum from C. Zukor and R. Howle, Alpha-Gamma Technologies, Inc., to Miscellaneous Organic NESHAP Project File. June 22, 1999. Existing Source MACT Floors for Surface Coating Manufacturing Processes.

2. Memorandum from C. Zukor and R. Howle, Alpha-Gamma Technologies, Inc., to Miscellaneous Organic NESHAP Project File. June 7, 1999. New Source MACT Floors for Surface Coating Manufacturing Processes.

3. Ranking of Equipment Leak Programs for the Miscellaneous Organic NESHAP. Alpha-Gamma Technologies, Inc. Draft. April 1999.

4. Memorandum from K. Meardon, Pacific Environmental Services, Inc., to J. Schaefer, EPA:ESD. May 4, 1998. Equipment Leak Analysis for Amino and Phenolic Resins NESHAP.

5. U. S. Environmental Protection Agency. Office of Air Quality Planning and Standards. Protocol for Equipment Leak Emission Estimates. EPA Document No. EPA-453/R-95-017. November 1995.

Attachment 1

MACT Floor Emissions and Cost Impacts

Coating Mfg. LDAR Program (MACT Floor)

	Facility #	Total Vessels at Plant	LDAR Program	Uncontrolled HAP (tons/yr)	Meet MACT floor?	Baseline HAP (tons/yr)	MACT Floor HAP Reduction (tons/yr)	MACT Floor TCI ($)	MACT Floor TAC ($/yr)	MACT Floor CE ($/ton)
1	21	13	Yes	2.10	No	2.10	0.60	$3,854	$1,299	$2,154
2	110	47	Yes	7.58	Yes	5.40	0.00	$0	$0	$0
3	118	82	Yes	13.22	Yes	9.41	0.00	$0	$0	$0
4	106	14	Yes	2.26	Yes	1.61	0.00	$0	$0	$0
5	29	43	Yes	6.93	Yes	4.94	0.00	$0	$0	$0
6	9	2	Yes	0.32	Yes	0.23	0.00	$0	$0	$0
7	7	3	Yes	0.48	Yes	0.34	0.00	$0	$0	$0
8	1	7	Yes	1.13	No	1.13	0.32	$3,447	$916	$2,822
9	16	59	Yes	9.51	Yes	6.77	0.00	$0	$0	$0
10	109	52	Yes	8.38	No	8.38	2.41	$6,498	$3,786	$1,569
11	26	5	Yes	0.81	No	0.81	0.23	$3,311	$789	$3,401
12	61	24	Yes	3.87	Yes	2.76	0.00	$0	$0	$0
13	34	27	Yes	4.35	Yes	3.10	0.00	$0	$0	$0
14	113	118	Yes	19.02	Yes	13.55	0.00	$0	$0	$0
15	49	65	Yes	10.48	Yes	7.46	0.00	$0	$0	$0
16	22	11	Yes	1.77	Yes	1.26	0.00	$0	$0	$0
17	101	17	Yes	2.74	Yes	1.95	0.00	$0	$0	$0
18	71	167	Yes	26.92	Yes	19.17	0.00	$0	$0	$0
19	73	166	Yes	26.76	No	26.76	7.70	$14,226	$11,057	$1,435
20	69	86	Yes	13.86	Yes	9.87	0.00	$0	$0	$0
21	72	29	Yes	4.67	Yes	3.33	0.00	$0	$0	$0
22	37	64	Yes	10.32	Yes	7.35	0.00	$0	$0	$0
23	114	41	Yes	6.61	No	6.61	1.90	$5,752	$3,085	$1,621
24	43	350	Yes	56.42	Yes	40.18	0.00	$0	$0	$0
25	86	43	Yes	6.93	Yes	4.94	0.00	$0	$0	$0
26	53	138	Yes	22.25	Yes	15.84	0.00	$0	$0	$0
27	30	9	Yes	1.45	Yes	1.03	0.00	$0	$0	$0
28	50	39	Yes	6.29	Yes	4.48	0.00	$0	$0	$0
29	27	3	Yes	0.48	Yes	0.34	0.00	$0	$0	$0
30	57	24	Yes	3.87	Yes	2.76	0.00	$0	$0	$0
31	58	17	Yes	2.74	Yes	1.95	0.00	$0	$0	$0
32	33	2	Yes	0.32	Yes	0.23	0.00	$0	$0	$0
33	82	44	Yes	7.09	Yes	5.05	0.00	$0	$0	$0
34	44	16	Yes	2.58	Yes	1.84	0.00	$0	$0	$0
35	51	34	Yes	5.48	Yes	3.90	0.00	$0	$0	$0
36	19	6	Yes	0.97	Yes	0.69	0.00	$0	$0	$0
37	25	39	Yes	6.29	Yes	4.48	0.00	$0	$0	$0
38	104	6	Yes	0.97	Yes	0.69	0.00	$0	$0	$0
39	103	94	Yes	15.15	Yes	10.79	0.00	$0	$0	$0
40	18	17	Yes	2.74	Yes	1.95	0.00	$0	$0	$0
41	105	100	Yes	16.12	Yes	11.48	0.00	$0	$0	$0
42	20	30	Yes	4.84	Yes	3.44	0.00	$0	$0	$0
43	14	12	Yes	1.93	Yes	1.38	0.00	$0	$0	$0
44	13	8	Yes	1.29	Yes	0.92	0.00	$0	$0	$0

Coating Mfg. LDAR Program (MACT Floor)

(continued)

	Facility #	Total Vessels at Plant	LDAR Program	Uncontrolled HAP (tons/yr)	Meet MACT floor?	Baseline HAP (tons/yr)	MACT Floor HAP Reduction (tons/yr)	MACT Floor TCI ($)	MACT Floor TAC ($/yr)	MACT Floor CE ($/ton)
45	12	5	Yes	0.81	Yes	0.57	0.00	$0	$0	$0
46	76	178	Yes	28.69	Yes	20.43	0.00	$0	$0	$0
47	15	38	Yes	6.13	No	6.13	1.76	$5,549	$2,893	$1,641
48	87	5	Yes	0.81	No	0.81	0.23	$3,311	$789	$3,401
49	28	7	Yes	1.13	No	1.13	0.32	$3,447	$916	$2,822
50	10	56		9.03	No	9.03	2.60	$6,769	$4,041	$1,555
51	47	72		11.61	No	11.61	3.34	$7,853	$5,062	$1,515
52	48	155		24.99	No	24.99	7.19	$13,480	$10,355	$1,439
53	46	113		18.22	No	18.22	5.24	$10,633	$7,677	$1,464
54	6	1		0.16	No	0.16	0.05	$3,040	$534	$11,510
55	41	64		10.32	No	10.32	2.97	$7,311	$4,552	$1,532
56	5	4		0.64	No	0.64	0.19	$3,244	$725	$3,908
57	4	20		3.22	No	3.22	0.93	$4,328	$1,745	$1,881
58	3	3		0.48	No	0.48	0.14	$3,176	$661	$4,753
59	2	31		5.00	No	5.00	1.44	$5,074	$2,447	$1,701
60	52	119		19.18	No	19.18	5.52	$11,040	$8,059	$1,460
61	8	96		15.48	No	15.48	4.45	$9,480	$6,592	$1,480
62	45	27		4.35	No	4.35	1.25	$4,803	$2,192	$1,750
63	11	24		3.87	No	3.87	1.11	$4,599	$2,001	$1,797
64	42	341		54.97	No	54.97	15.82	$26,089	$22,219	$1,404
65	40	31		5.00	No	5.00	1.44	$5,074	$2,447	$1,701
66	39	293		47.23	No	47.23	13.60	$22,835	$19,157	$1,409
67	36	4		0.64	No	0.64	0.19	$3,244	$725	$3,908
68	35	3		0.48	No	0.48	0.14	$3,176	$662	$4,753
69	32	28		4.51	No	4.51	1.30	$4,871	$2,256	$1,737
70	31	81		13.06	No	13.06	3.76	$8,463	$5,636	$1,500
71	23	83		13.38	No	13.38	3.85	$8,599	$5,764	$1,497
72	24	30		4.84	No	4.84	1.39	$5,006	$2,384	$1,712
73	66	71		11.45	No	11.45	3.29	$7,786	$4,999	$1,517
74	17	12		1.93	No	1.93	0.56	$3,786	$1,236	$2,219
75	115	217		34.98	No	34.98	10.07	$17,683	$14,310	$1,421
76	94	26		4.19	No	4.19	1.21	$4,735	$2,129	$1,764
77	95	116		18.70	No	18.70	5.38	$10,836	$7,869	$1,462
78	96	56		9.03	No	9.03	2.60	$6,769	$4,042	$1,556
79	97	22		3.55	No	3.55	1.02	$4,464	$1,873	$1,835
80	98	75		12.09	No	12.09	3.48	$8,057	$5,254	$1,510
81	99	66		10.64	No	10.64	3.06	$7,447	$4,680	$1,528
82	100	35		5.64	No	5.64	1.62	$5,345	$2,703	$1,664
83	102	234		37.72	No	37.72	10.86	$18,835	$15,394	$1,418
84	107	13		2.10	No	2.10	0.60	$3,854	$1,299	$2,154
85	108	40		6.45	No	6.45	1.86	$5,684	$3,021	$1,628
86	64	153		24.66	No	24.66	7.10	$13,344	$10,228	$1,441
87	112	32		5.16	No	5.16	1.48	$5,142	$2,511	$1,691

Coating Mfg. LDAR Program (MACT Floor)
(continued)

	Facility #	Total Vessels at Plant	LDAR Program	Uncontrolled HAP (tons/yr)	Meet MACT floor?	Baseline HAP (tons/yr)	MACT Floor HAP Reduction (tons/yr)	MACT Floor TCI ($)	MACT Floor TAC ($/yr)	MACT Floor CE ($/ton)
88	91	61		9.83	No	9.83	2.83	$7,108	$4,361	$1,541
89	116	126		20.31	No	20.31	5.85	$11,514	$8,506	$1,455
90	117	8		1.29	No	1.29	0.37	$3,515	$981	$2,642
91	119	97		15.64	No	15.64	4.50	$9,548	$6,657	$1,479
92	120	71		11.45	No	11.45	3.29	$7,786	$4,999	$1,517
93	121	93		14.99	No	14.99	4.32	$9,277	$6,402	$1,484
94	122	37		5.96	No	5.96	1.72	$5,481	$2,830	$1,648
95	123	48		7.74	No	7.74	2.23	$6,226	$3,532	$1,586
96	124	147		23.70	No	23.70	6.82	$12,938	$9,846	$1,443
97	125	30		4.84	No	4.84	1.39	$5,006	$2,384	$1,712
98	126	79		12.73	No	12.73	3.67	$8,328	$5,509	$1,503
99	127	66		10.64	No	10.64	3.06	$7,447	$4,680	$1,528
100	111	6		0.97	No	0.97	0.28	$3,379	$853	$3,064
101	77	166		26.76	No	26.76	7.70	$14,226	$11,057	$1,436
102	55	12		1.93	No	1.93	0.56	$3,786	$1,236	$2,219
103	56	31		5.00	No	5.00	1.44	$5,074	$2,447	$1,701
104	59	134		21.60	No	21.60	6.22	$12,056	$9,017	$1,450
105	60	8		1.29	No	1.29	0.37	$3,515	$981	$2,642
106	62	14		2.26	No	2.26	0.65	$3,922	$1,363	$2,099
107	63	35		5.64	No	5.64	1.62	$5,345	$2,703	$1,664
108	65	45		7.25	No	7.25	2.09	$6,023	$3,340	$1,600
109	128	68		10.96	No	10.96	3.16	$7,582	$4,807	$1,524
110	67	126		20.31	No	20.31	5.85	$11,514	$8,506	$1,455
111	68	38		6.13	No	6.13	1.76	$5,549	$2,894	$1,641
112	70	53		8.54	No	8.54	2.46	$6,565	$3,851	$1,566
113	93	50		8.06	No	8.06	2.32	$6,362	$3,659	$1,577
114	75	51		8.22	No	8.22	2.37	$6,430	$3,723	$1,573
115	92	4		0.64	No	0.64	0.19	$3,244	$725	$3,908
116	78	211		34.01	No	34.01	9.79	$17,276	$13,927	$1,423
117	79	19		3.06	No	3.06	0.88	$4,261	$1,682	$1,908
118	80	55		8.87	No	8.87	2.55	$6,701	$3,978	$1,559
119	81	134		21.60	No	21.60	6.22	$12,056	$9,017	$1,450
120	83	6		0.97	No	0.97	0.28	$3,379	$853	$3,064
121	84	10		1.61	No	1.61	0.46	$3,650	$1,108	$2,388
122	85	48		7.74	No	7.74	2.23	$6,226	$3,532	$1,586
123	88	101		16.28	No	16.28	4.69	$9,819	$6,912	$1,475
124	89	40		6.45	No	6.45	1.86	$5,684	$3,021	$1,628
125	90	14		2.26	No	2.26	0.65	$3,922	$1,363	$2,099
126	54	19		3.06	No	3.06	0.88	$4,261	$1,682	$1,908
127	74	25		4.03	No	4.03	1.16	$4,667	$2,065	$1,780
				1,231		1,135	258	$636,037	$395,968	$1,533

Attachment 2

Regulatory Alternative Emissions and Cost Impacts

Coating Mgf. LDAR Program (Above Floor)

	Facility #	Total Vessels at Plant	LDAR Program	Uncontrolled HAP (tons/yr)	Meet Regulatory alternative?	Baseline HAP (tons/yr)	Reg. Alt. HAP Reduction (tons/yr)	Regulatory alternative TCI ($)	Regulatory alternative TAC ($/yr)	Regulatory alternative CE ($/ton)
1	21	13	Yes	2.10	No	2.10	1.28	$5,717	$7,022	$5,467
2	110	47	Yes	7.58	No	5.40	2.46	$1,709	$7,235	$2,938
3	118	82	Yes	13.22	No	9.41	4.30	$1,550	$8,791	$2,046
4	106	14	Yes	2.26	No	1.61	0.73	$1,858	$5,767	$7,861
5	29	43	Yes	6.93	No	4.94	2.25	$1,727	$7,057	$3,132
6	9	2	Yes	0.32	No	0.23	0.10	$1,913	$5,233	$49,936
7	7	3	Yes	0.48	No	0.34	0.16	$1,908	$5,278	$33,574
8	1	7	Yes	1.13	No	1.13	0.69	$5,338	$6,372	$9,214
9	16	59	Yes	9.51	No	6.77	3.09	$1,654	$7,768	$2,513
10	109	52	Yes	8.38	No	8.38	5.14	$8,184	$11,244	$2,189
11	26	5	Yes	0.81	No	0.81	0.49	$5,211	$6,156	$12,461
12	61	24	Yes	3.87	No	2.76	1.26	$1,813	$6,212	$4,939
13	34	27	Yes	4.35	No	3.10	1.41	$1,799	$6,345	$4,485
14	113	118	Yes	19.02	No	13.55	6.18	$1,386	$10,392	$1,681
15	49	65	Yes	10.48	No	7.46	3.41	$1,627	$8,035	$2,359
16	22	11	Yes	1.77	No	1.26	0.58	$1,872	$5,634	$9,774
17	101	17	Yes	2.74	No	1.95	0.89	$1,845	$5,900	$6,624
18	71	167	Yes	26.92	No	19.17	8.75	$1,164	$12,571	$1,437
19	73	166	Yes	26.76	No	26.76	16.40	$15,395	$23,584	$1,438
20	69	86	Yes	13.86	No	9.87	4.51	$1,532	$8,969	$1,990
21	72	29	Yes	4.67	No	3.33	1.52	$1,790	$6,434	$4,234
22	37	64	Yes	10.32	No	7.35	3.35	$1,631	$7,991	$2,383
23	114	41	Yes	6.61	No	6.61	4.05	$7,488	$10,053	$2,482
24	43	350	Yes	56.42	No	40.18	18.34	$333	$20,710	$1,129
25	86	43	Yes	6.93	No	4.94	2.25	$1,727	$7,057	$3,132
26	53	138	Yes	22.25	No	15.84	7.23	$1,295	$11,282	$1,560
27	30	9	Yes	1.45	No	1.03	0.47	$1,881	$5,545	$11,757
28	50	39	Yes	6.29	No	4.48	2.04	$1,745	$6,879	$3,366
29	27	3	Yes	0.48	No	0.34	0.16	$1,908	$5,278	$33,574
30	57	24	Yes	3.87	No	2.76	1.26	$1,813	$6,212	$4,939
31	58	17	Yes	2.74	No	1.95	0.89	$1,845	$5,900	$6,624
32	33	2	Yes	0.32	No	0.23	0.10	$1,913	$5,233	$49,936
33	82	44	Yes	7.09	No	5.05	2.31	$1,722	$7,101	$3,080
34	44	16	Yes	2.58	No	1.84	0.84	$1,849	$5,856	$6,985
35	51	34	Yes	5.48	No	3.90	1.78	$1,768	$6,656	$3,736
36	19	6	Yes	0.97	No	0.69	0.31	$1,895	$5,411	$17,211
37	25	39	Yes	6.29	No	4.48	2.04	$1,745	$6,879	$3,366
38	104	6	Yes	0.97	No	0.69	0.31	$1,895	$5,411	$17,211
39	103	94	Yes	15.15	No	10.79	4.93	$1,495	$9,325	$1,893
40	18	17	Yes	2.74	No	1.95	0.89	$1,845	$5,900	$6,624
41	105	100	Yes	16.12	No	11.48	5.24	$1,468	$9,592	$1,830
42	20	30	Yes	4.84	No	3.44	1.57	$1,786	$6,479	$4,121
43	14	12	Yes	1.93	No	1.38	0.63	$1,868	$5,678	$9,030
44	13	8	Yes	1.29	No	0.92	0.42	$1,886	$5,500	$13,121

Coating Mgf. LDAR Program (Above Floor)
(continued)

	Facility #	Total Vessels at Plant	LDAR Program	Uncontrolled HAP (tons/yr)	Meet Regulatory alternative?	Baseline HAP (tons/yr)	Reg. Alt. HAP Reduction (tons/yr)	Regulatory alternative TCI ($)	Regulatory alternative TAC ($/yr)	Regulatory alternative CE ($/ton)
45	12	5	Yes	0.81	No	0.57	0.26	$1,899	$5,367	$20,484
46	76	178	Yes	28.69	No	20.43	9.33	$1,114	$13,060	$1,400
47	15	38	Yes	6.13	No	6.13	3.75	$7,299	$9,728	$2,591
48	87	5	Yes	0.81	No	0.81	0.49	$5,211	$6,156	$12,461
49	28	7	Yes	1.13	No	1.13	0.69	$5,338	$6,372	$9,214
50	10	56		9.03	No	9.03	5.53	$8,437	$11,677	$2,110
51	47	72		11.61	No	11.61	7.11	$9,449	$13,409	$1,885
52	48	155		24.99	No	24.99	15.31	$14,699	$22,393	$1,462
53	46	113		18.22	No	18.22	11.16	$12,042	$17,847	$1,599
54	6	1		0.16	No	0.16	0.10	$4,958	$5,723	$57,925
55	41	64		10.32	No	10.32	6.32	$8,943	$12,543	$1,984
56	5	4		0.64	No	0.64	0.40	$5,148	$6,048	$15,303
57	4	20		3.22	No	3.22	1.98	$6,160	$7,780	$3,937
58	3	3		0.48	No	0.48	0.30	$5,085	$5,939	$20,039
59	2	31		5.00	No	5.00	3.06	$6,856	$8,970	$2,929
60	52	119		19.18	No	19.18	11.76	$12,422	$18,496	$1,573
61	8	96		15.48	No	15.48	9.48	$10,967	$16,007	$1,688
62	45	27		4.35	No	4.35	2.67	$6,603	$8,537	$3,200
63	11	24		3.87	No	3.87	2.37	$6,413	$8,213	$3,464
64	42	341		54.97	No	54.97	33.69	$26,463	$42,528	$1,262
65	40	31		5.00	No	5.00	3.06	$6,856	$8,970	$2,929
66	39	293		47.23	No	47.23	28.95	$23,427	$37,332	$1,290
67	36	4		0.64	No	0.64	0.40	$5,148	$6,048	$15,303
68	35	3		0.48	No	0.48	0.30	$5,085	$5,939	$20,039
69	32	28		4.51	No	4.51	2.77	$6,666	$8,646	$3,125
70	31	81		13.06	No	13.06	8.00	$10,018	$14,383	$1,797
71	23	83		13.38	No	13.38	8.20	$10,145	$14,599	$1,780
72	24	30		4.84	No	4.84	2.96	$6,793	$8,862	$2,990
73	66	71		11.45	No	11.45	7.01	$9,386	$13,300	$1,896
74	17	12		1.93	No	1.93	1.19	$5,654	$6,914	$5,831
75	115	217		34.98	No	34.98	21.44	$18,620	$29,105	$1,358
76	94	26		4.19	No	4.19	2.57	$6,540	$8,429	$3,281
77	95	116		18.70	No	18.70	11.46	$12,232	$18,172	$1,586
78	96	56		9.03	No	9.03	5.53	$8,437	$11,677	$2,110
79	97	22		3.55	No	3.55	2.17	$6,287	$7,996	$3,679
80	98	75		12.09	No	12.09	7.41	$9,639	$13,733	$1,853
81	99	66		10.64	No	10.64	6.52	$9,070	$12,759	$1,957
82	100	35		5.64	No	5.64	3.46	$7,109	$9,403	$2,719
83	102	234		37.72	No	37.72	23.12	$19,696	$30,945	$1,339
84	107	13		2.10	No	2.10	1.28	$5,717	$7,022	$5,467
85	108	40		6.45	No	6.45	3.95	$7,425	$9,945	$2,516
86	64	153		24.66	No	24.66	15.12	$14,572	$22,177	$1,467
87	112	32		5.16	No	5.16	3.16	$6,919	$9,079	$2,872

Coating Mgf. LDAR Program (Above Floor)

(continued)

	Facility #	Total Vessels at Plant	LDAR Program	Uncontrolled HAP (tons/yr)	Meet Regulatory alternative?	Baseline HAP (tons/yr)	Reg. Alt. HAP Reduction (tons/yr)	Regulatory alternative TCI ($)	Regulatory alternative TAC ($/yr)	Regulatory alternative CE ($/ton)
88	91	61		9.83	No	9.83	6.03	$8,753	$12,218	$2,027
89	116	126		20.31	No	20.31	12.45	$12,865	$19,254	$1,547
90	117	8		1.29	No	1.29	0.79	$5,401	$6,481	$8,199
91	119	97		15.64	No	15.64	9.58	$11,030	$16,115	$1,682
92	120	71		11.45	No	11.45	7.01	$9,386	$13,300	$1,896
93	121	93		14.99	No	14.99	9.19	$10,777	$15,682	$1,707
94	122	37		5.96	No	5.96	3.66	$7,235	$9,620	$2,632
95	123	48		7.74	No	7.74	4.74	$7,931	$10,811	$2,280
96	124	147		23.70	No	23.70	14.52	$14,193	$21,527	$1,482
97	125	30		4.84	No	4.84	2.96	$6,793	$8,862	$2,990
98	126	79		12.73	No	12.73	7.81	$9,892	$14,166	$1,815
99	127	66		10.64	No	10.64	6.52	$9,070	$12,759	$1,957
100	111	6		0.97	No	0.97	0.59	$5,275	$6,264	$10,567
101	77	166		26.76	No	26.76	16.40	$15,395	$23,584	$1,438
102	55	12		1.93	No	1.93	1.19	$5,654	$6,914	$5,831
103	56	31		5.00	No	5.00	3.06	$6,856	$8,970	$2,929
104	59	134		21.60	No	21.60	13.24	$13,371	$20,120	$1,520
105	60	8		1.29	No	1.29	0.79	$5,401	$6,481	$8,199
106	62	14		2.26	No	2.26	1.38	$5,781	$7,130	$5,155
107	63	35		5.64	No	5.64	3.46	$7,109	$9,403	$2,719
108	65	45		7.25	No	7.25	4.45	$7,741	$10,486	$2,359
109	128	68		10.96	No	10.96	6.72	$9,196	$12,976	$1,931
110	67	126		20.31	No	20.31	12.45	$12,865	$19,254	$1,547
111	68	38		6.13	No	6.13	3.75	$7,299	$9,728	$2,591
112	70	53		8.54	No	8.54	5.24	$8,247	$11,352	$2,168
113	93	50		8.06	No	8.06	4.94	$8,058	$11,027	$2,232
114	75	51		8.22	No	8.22	5.04	$8,121	$11,135	$2,210
115	92	4		0.64	No	0.64	0.40	$5,148	$6,048	$15,303
116	78	211		34.01	No	34.01	20.85	$18,241	$28,455	$1,365
117	79	19		3.06	No	3.06	1.88	$6,097	$7,671	$4,087
118	80	55		8.87	No	8.87	5.43	$8,374	$11,568	$2,129
119	81	134		21.60	No	21.60	13.24	$13,371	$20,120	$1,520
120	83	6		0.97	No	0.97	0.59	$5,275	$6,264	$10,567
121	84	10		1.61	No	1.61	0.99	$5,528	$6,697	$6,779
122	85	48		7.74	No	7.74	4.74	$7,931	$10,811	$2,280
123	88	101		16.28	No	16.28	9.98	$11,283	$16,548	$1,658
124	89	40		6.45	No	6.45	3.95	$7,425	$9,945	$2,516
125	90	14		2.26	No	2.26	1.38	$5,781	$7,130	$5,155
126	54	19		3.06	No	3.06	1.88	$6,097	$7,671	$4,087
127	74	25		4.03	No	4.03	2.47	$6,476	$8,321	$3,369
				1,231		1,135	658	$845,451	$1,389,029	$2,109

Attachment 3

Uncontrolled, MACT Floor, and Regulatory Alternative Emission Factors

Uncontrolled Batch **Vinyl Acetate** **Cumene**

Component	Factor (kg/hr-source)	Count	Hrs of Op (hr/yr)	HAP Emissions (tons/yr)		Factor (kg/hr-source)	Count	Hrs of Op (hr/yr)	HAP Emissions (tons/yr)
Valves LL	0.00023	30	8760	0.07		0.006	30	8760	1.74
Pumps LL	0.002	6	8760	0.12		0.018	6	8760	1.04
Flanges	0.001258	100	8760	1.21		0.003358	100	8760	3.24
Open Lines	0.0017	2	8760	0.03		0.0017	2	8760	0.03
Sampling	0.015	2	8760	0.29		0.015	2	8760	0.29
		140	8760				140	8760	
				1.72	**4.03**				6.35

SOCMI VV Batch **Vinyl Acetate** **Cumene**

Component	Factor (kg/hr-source)	Count	Hrs of Op (hr/yr)	HAP Emissions (tons/yr)		Factor (kg/hr-source)	Count	Hrs of Op (hr/yr)	HAP Emissions (tons/yr)
Valves LL	0.000228	30	8760	0.07		0.001148	30	8760	0.33
Pumps LL	0.001329	6	8760	0.08		0.0027	6	8760	0.16
Flanges	0.001258	100	8760	1.21		0.003358	100	8760	3.24
Open Lines	0.0017	2	8760	0.03		0.0017	2	8760	0.03
Sampling	0.015	2	8760	0.29		0.015	2	8760	0.29
		140	8760				140	8760	
				1.68	**2.87**	29%			4.05

HON Batch **Vinyl Acetate** **Cumene**

Component	Factor (kg/hr-source)	Count	Hrs of Op (hr/yr)	HAP Emissions (tons/yr)		Factor (kg/hr-source)	Count	Hrs of Op (hr/yr)	HAP Emissions (tons/yr)
Valves LL	0.000146	30	8760	0.04		0.000886	30	8760	0.26
Pumps LL	0.000675	6	8760	0.04		0.001903	6	8760	0.11
Flanges	0.000707	100	8760	0.68		0.001395	100	8760	1.35
Open Lines	0.0017	2	8760	0.03		0.0017	2	8760	0.03
Sampling	0.015	2	8760	0.29		0.015	2	8760	0.29
		140	8760				140	8760	
				1.09	**1.56**	61%	46%		2.04

Attachment 4

Data and Equations Used to Estimate Costs

TABLE 1. DATA FOR PUMPS, VALVES, AND CONNECTORS

Parameter	Monitoring Factor		
	Pumps	Valves	Connectors
Monitoring frequency	Monthly	Quarterly	Annually
Initial monitoring time, min/component	10	2	2
Subsequent monitoring time, min/component	10	2	2
Components repaired online, percent	100	75	75
Components repaired offline, percent		25	25
Repair time online, hr	16	0.17	0.17
Repair time offline, hr		4.0	2.0
Initial leak frequency, percent			
MACT floor[a]	7.48	4.34	1.55
Regulatory alternative[b]	9.37	8.50	3.90
Subsequent leak frequency, percent			
MACT floor[c]	1.77	0.54	0.138
Regulatory alternative[d]	4.21	2.00	0.50

[a] Calculated using SOCMI average emission factors in ALR equations (Table 5-4 in reference 5) for leak definition of 10,000 ppmv.

[b] Calculated using SOCMI average emission factors in ALR equations (Table 5-4 in reference 5) for leak definitions of 500 ppmv for valves and connectors and 5,000 ppmv for pumps.

[c] Procedures used to develop the subsequent leak frequencies are described in the footnote to Table 1 in attachment 3 in reference 4.

[d] Subsequent leak frequencies obtained using procedures described in appendix G.2 in reference 5.

TABLE 2. MISCELLANEOUS COSTS AND COST FACTORS[a]

Parameter	Cost or cost factor	Comments
Initial equipment cost		
Control for open-ended lines	\$102	Gate valve
Control for sampling connections	\$409	Closed purge system
Data collection system	\$1,200	
Pump seal replacement cost	\$180	
Monitoring instrument[b]		
Rental	\$180/day	12/year
Calibration	\$41.25/day	12/year
Annual administrative and reporting[b]	60 hr	
Initial training		
MACT floor	48 hr	Assumed
Regulatory alternative	100 hr	Assumed
Labor costs		
Monitoring and repair	\$22.50/hr	
Administrative, reporting, and training	\$36.95/hr	Weighted average of technical (\$33x1), secretarial (\$15x0.1), and management (\$49x0.05) burden
Capital recovery factor		
Pump replacement seals	0.244	5 years and 7% interest
All other initial costs	0.142	10 years and 7% interest

[a] All costs in 1989 dollars, except monitoring instrument rental costs, which are in 1997
[b] Only for the regulatory alternative

TABLE 3. EQUATIONS USED IN COST ANALYSIS

Parameter	Equation
Initial number of leaks (all components)	(No. of components in model)x(initial leak frequency)
Annual monitoring cost	
Valves and connectors	(No. of components in model)x(monitoring time)x(monitoring frequency)x($22.50/hr)
Pumps[a]	(No. of components in model)x(monitoring time x monitoring frequency +0.5x60x52)
Annual number of leaks (all components)	(No. of components in model)x(subsequent leak frequency)x(frequency of monitoring)
Annual online repair cost	(Annual number of leaks)x(percent repaired online)x(online repair time)x(repair labor rate)
Annual offline repair cost	(Annual number of leaks)x(percent repaired offline)x(offline repair time)x(repair labor rate)
Annual maintenance cost	
Pumps	(Annual number of leaks)x(pump seal replacement cost)
Open-ended lines and sampling connections	(Initial control equipment cost)x(0.05)
Annual miscellaneous charges	
Pumps	(Annual maintenance cost)x(0.8)
Open-ended lines and sampling connections	(Initial control equipment cost)x(0.04)
Data collection system	(Initial equipment cost)x(0.04)
Data entry costs	
Initial records	($1.88/component)x(Number of components in model)
Subsequent records (annual)	($0.75/component)x(Number of components in model)
Recovery credit	($200/ton)x(emission reduction, ton/yr)

[a] Includes weekly visual monitoring of 0.5 minute per pump.

Attachment 5

Spreadsheets Used to Estimate MACT Floor and Regulatory Alternative Costs
for the Smallest Model Facility

TABLE 1. HON PROGRAM COSTS FOR 25 VESSELS

Type of Component	Number of Components	Initial Monitoring Fee or Unit Cost ($/comp)	Initial LDAR Costs ($/yr) (Capital)	Initial LDAR Admin. Costs	Frequency of Monitoring (times/yr)	Subsequent Monitoring Fee ($/comp) or Charge (%)	Annual Monitoring Costs ($/yr)	Annual Maintenance Costs ($/yr)
Pump Seals								
* Light-liquid service	6	3.75	224.89		12	6.75	544.50	566.08
* Heavy-liquid service								
Valves								
* Gas/vapor service		0.75	0.00		4	0.75	0.00	0.00
* Light-liquid service	30	0.75	93.44		4	0.75	90.00	1.80
* Heavy-liquid service								
Connectors								
* Flanges - gas/vapor		0.75	0.00		1	0.75	0.00	0.00
* Flanges - light liquid	100	0.75	139.62		1	0.75	75.00	0.38
* Flanges -heavy liquid								
Pressure Relief Devices								
* Disks		78.00	0.00		1	2.00	0.00	0.00
* Disk holders, valves, etc.		3852.00	0.00		1	5.00		0.00
Open-ended Valves	2	102.00	204.00			5.00		10.20
Sampling Connections	2	409.00	818.00			5.00		40.90
Compressor Vent		6242.00	0.00			5.00		0.00
Replacement Pump Seals	6	180.00	101.20					
Monitoring Device	0	6500.00	0.00					0.00
Monitoring Device - Rent	1						2655.00	
Data Collection System	1	1200.00	1200.00					
Administrative and Reports	60	36.95						
Planning and Training	100	36.95		3695.00				
TOTALS			2781.14	3695.00			3364.50	619.35
Capital Costs	6,476							
Annualized Capital Costs	930							
Annual Expenses	7,885							
Annual Fixed Costs ($/yr)		3,672						
Annual Variable Costs ($/yr)		5,143						
Recovery Credits	494							
Net Annual Costs	8,321							
Emission Reduction (tons/yr)	2.47							
Cost Effectiveness ($/ton)	3,369							

TABLE 1. HON PROGRAM COSTS FOR 25 VESSELS (continued)

Type of Component	Initial Leak Frequency (%)	Initial Number of Leaks	Subsequent Leak Frequency (%)	Annual Number of Leaks	Percent Repaired OnLine	Repair Time (hours)	Labor Charge ($/hr)	Annual OnLine Leak Repair Cost ($/yr)	Percent Requiring Further Repair	Repair Time (hours)	Labor Charge ($/hr)	Annual Offline Leak Repair Cost ($/yr)	Annual Admin. Cost ($/yr)	Annual Misc. Charges ($/yr)
Pump Seals														
* Light-liquid service	9.37	0.56	4.21	3.03	100	16.00	22.50	1091.23	0	80.00	22.50	0.00		436.49
* Heavy-liquid service														
Valves														
* Gas/vapor service	13.60	0.00	2.00	0.00	75	0.17	22.50	0.00	25	4.00	22.50	0.00		
* Light-liquid service	8.50	2.55	2.00	2.40	75	0.17	22.50	6.76	25	4.00	22.50	54.00		
* Heavy-liquid service														
Connectors														
* Flanges - gas/vapor	3.90	0.00	0.50	0.00	75	0.17	22.50	0.00	25	2.00	22.50	0.00		
* Flanges - light liquid	3.90	3.90	0.50	0.50	75	0.17	22.50	1.41	25	2.00	22.50	5.63		
* Flanges -heavy liquid														
Pressure Relief Devices														
* Disks		0.00		0.00										0.00
* Disk holders, valves,etc.		0.00		0.00										0.00
Open-ended Valves		0.00		0.00										8.16
Sampling Connections		0.00		0.00										32.72
Compressor Vent		0.00		0.00										0.00
Replacement Pump Seals														
Monitoring Device														0.00
Monitoring Device - Rent														
Data Collection System														48.00
Administrative and Reports													2217.00	
Planning and Training														
TOTALS								1099.40				59.63	2217.00	525.37

Monitoring Instrument Rental:

No. of Days In Rental Period	No. of Rental Periods/yr	Cost per Rental Period	Rental Costs	Daily Calibration Costs
				41.25
1	12	180.00	2160.00	495.00
2		190.00	0.00	0.00
3		245.00	0.00	0.00
6		405.00	0.00	0.00
15		830.00	0.00	0.00
			2160.00	495.00

TABLE 2. SENSORY PROGRAM COST FOR 25 VESSELS

Type of Component	Number of Components	Initial Monitoring Fee or Unit Cost ($/comp)	Initial LDAR Costs ($/yr) (Capital)	Initial LDAR Admin. Costs	Frequency of Monitoring (times/yr)	Subsequent Monitoring Fee ($/comp) or Charge (%)	Annual Monitoring Costs ($/yr)	Annual Maintenance Costs ($/yr)
Pump Seals								
* Light-liquid service	6	3.75	184.07		12	3.75	328.50	229.39
* Heavy-liquid service								
Valves								
* Gas/vapor service		0.75	0.00		4	0.75	0.00	
* Light-liquid service	30	0.75	55.46		4	0.75	90.00	
* Heavy-liquid service								
Connectors								
* Flanges - gas/vapor		0.75	0.00		1	0.75	0.00	
* Flanges - light liquid	100	0.75	96.81		1	0.75	75.00	
* Flanges -heavy liquid								
Pressure Relief Devices								
* Disks		78.00	0.00		1	2.00	0.00	0.00
* Disk holders, valves, etc.	0	3852.00	0.00		1	5.00		0.00
Open-ended Valves	2	102.00	204.00			5.00		10.20
Sampling Connections	2	409.00	818.00			5.00		40.90
Compressor Vent		6242.00	0.00			5.00		0.00
Replacement Pump Seals	6	180.00	80.78					
Monitoring Device - Buy		6500.00	0.00					0.00
Monitoring Device - Rent	0							
Data Collection System	1	1200.00	1200.00					
Administrative and Reports	0	36.95						
Planning and Training	48	36.95		1773.60				
Data Entry - Initial	136	1.88	255.68					
Data Entry - Subsequent	136	0.75					102.00	
TOTALS			2894.80	1773.60			595.50	280.49
Capital Costs	4,668							
Annualized Capital Costs	671							
Annual Expenses	1,626							
Annual Fixed Costs ($/yr)		944						
Annual Variable Costs ($/yr)		1,353						
Recovery Credits	232							
Net Annual Costs	2,065							
Emission Reduction (tons/yr)	1.16							
Cost Effectiveness ($/ton)	1,780							

TABLE 2. SENSORY PROGRAM COST FOR 25 VESSELS (continued)

Type of Component	Initial Leak Frequency (%)	Initial Number of Leaks	Subsequent Leak Frequency (%)	Annual Number of Leaks	Percent Repaired OnLine	Repair Time (hours)	Labor Charge ($/hr)	Annual OnLine Leak Repair Cost ($/yr)	Percent Requiring Further Repair	Repair Time (hours)	Labor Charge ($/hr)	Annual Offline Leak Repair Cost ($/yr)	Annual Admin. Cost ($/yr)	Annual Misc. Charges ($/yr)
Pump Seals														
* Light-liquid service	7.48	0.45	1.77	1.27	100	16.00	22.50	458.78	0	80.00	22.50	0.00		183.51
* Heavy-liquid service														
Valves														
* Gas/vapor service	7.48	0.00	2.33	0.00	75	0.17	22.50	0.00	25	4.00	22.50	0.00		
* Light-liquid service	4.34	1.30	0.54	0.65	75	0.17	22.50	1.83	25	4.00	22.50	14.58		
* Heavy-liquid service														
Connectors														
* Flanges - gas/vapor	1.55	0.00	0.138	0.00	75	0.17	22.50	0.00	25	2.00	22.50	0.00		
* Flanges - light liquid	1.55	1.55	0.138	0.14	75	0.17	22.50	0.39	25	2.00	22.50	1.55		
* Flanges -heavy liquid														
Pressure Relief Devices														
* Disks		0.00												0.00
* Disk holders, valves, etc.		0.00												0.00
Open-ended Valves		0.00												8.16
Sampling Connections		0.00												32.72
Compressor Vent		0.00												0.00
Replacement Pump Seals														
Monitoring Device - Buy														0.00
Monitoring Device - Rent														
Data Collection System														48.00
Administrative and Reports													0.00	
Planning and Training														
Data Entry - Initial														
Data Entry - Subsequent														
TOTALS								461.00				16.13	0.00	272.39

Monitoring Instrument Rental:

MRI

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Date: July 17, 2000

Subject: Condenser Exit Gas Default Temperatures
Coatings Manufacturing Source Category
Miscellaneous Organic NESHAP
EPA Project No. 95/08; MRI Project No. 104803.1.049

From: Brenda Shine, North State Engineering

To: MON Project File

I. Introduction

The proposed Subpart HHHHH allows owners and operators to demonstrate compliance with the MACT standards by operating and monitoring condensers to control displacement emissions from process vessels. To simplify the option, the proposed rule also specifies condenser exit gas temperatures based on material vapor pressure. The condenser temperatures correspond generally to the existing and new source reduction requirements (75 percent and 95 percent from an uncontrolled basis, respectively). This memorandum describes how the condenser default temperatures that are specified in the proposed Subpart HHHHH were developed.

II. Development of Temperature Defaults

Table 1 contains the information used to select the default temperatures. HAP usage from the Section 114 database was first obtained to determine predominant HAPs in the industry. Next, vapor pressures of the predominant HAP saturated at 25EC were calculated using Antoine's coefficients to determine the expected vapor fraction under uncontrolled conditions. Finally, temperatures required to achieve both a 75 percent reduction and a 95 percent reduction from uncontrolled were calculated using the inverse of the Antoine equation. The temperatures correspond to pure component vapor pressures equal to 25 percent and 5 percent of the pure component vapor pressures at 25EC.

From Table 1, it is possible to identify condenser exit gas temperatures that can be used to verify that condensers meet the proposed MACT requirements for various HAPs. To simplify requirements, we selected three minimum exit gas temperatures that corresponded to ranges of vapor pressures in the table. In selecting the ranges, we also considered the accuracy range of

±2.5EC (or ±2.2EC) that is required in MACT standards. Therefore, we concluded that ranges had to differ by at least 6 degrees.

Based on this method, we set the following temperatures that corresponded to three ranges of vapor pressures:

HAP partial pressure ranges at 25EC, kPa (psia)	Required outlet gas temperature for 75% reduction, EC	Required outlet gas temperature for 95% reduction, EC
<0.7 kPa (0.1 psia)	10	-4
$0.7 kPa (0.1 psia) to <17.2 kPa (2.5 psia)	2	-20
$17.2 kPa (2.5 psia)	-5	-30

III. Conclusions

Based on the method that was used to develop these temperatures, they are appropriate for process vessels at ambient conditions only.

TABLE 1. EXIT GAS CONDENSER TEMPERATURES REQUIRED FOR 75 PERCENT AND 95 PERCENT CONTROL

HAP	Usage, gal/yr	Antoine's coefficients			Vapor pressures at 25 EC		Vapor pressure required for		Required temp for 75% reduction		Required temp for 95% reduction	
		a	b	c	(mmHg)	(psia)	75% red (mmHg)	95% red (mmHg)	C	F	C	F
methylene chloride	118709	7.409	1325.9	252.6	429.24	8.302	107.31	21.462	-6.07	21.07	-34.43	-29.97
hexane	754605	6.876	1171.17	224.41	151.44	2.929	37.86	7.572	-3.34	25.98	-29.11	-20.40
methanol	2205833	7.897	1474.08	229.13	124.88	2.416	31.22	6.244	1.10	33.99	-21.56	-6.80
methyl ethyl ketone	8993879	6.97421	1209.6	216	90.18	1.744	22.55	4.509	-0.81	30.54	-24.61	-12.30
methyl methacrylate	6362077	8.409	2050.5	274.4	36.33	0.703	9.08	1.817	0.81	33.45	-22.80	-9.03
toluene	37070580	6.954	1344.8	219.48	28.40	0.549	7.10	1.420	0.88	33.59	-21.76	-7.18
methyl isobutyl ketone	6842305	6.672	1168.4	191.9	19.28	0.373	4.82	0.964	3.20	37.75	-17.19	1.05
ethylbenzene	1199486	6.975	1424.255	213.21	9.91	0.192	2.48	0.495	3.21	37.77	-17.57	0.37
xylenes	30322632	6.998	1474.679	213.69	6.60	0.128	1.65	0.330	3.81	38.85	-16.52	2.26
styrene	1056722	7.14	1574.51	224.09	6.59	0.127	1.65	0.330	3.34	38.01	-17.52	0.47
cumene	85994	6.963	1460.793	207.78	4.87	0.094	1.22	0.244	4.62	40.32	-14.97	5.05
phenol	522923	7.133	1516.79	174.95	0.35	0.007	0.09	0.018	10.30	50.54	-4.27	24.31
naphthalene	110347	7.01	1733.71	201.86	0.23	0.005	0.06	0.012	8.43	47.18	-8.00	17.59
cresols o	224322	6.911	1435.5	165.16	0.23	0.004	0.06	0.012	10.95	51.72	-2.96	26.68
cresols m		7.508	1856.36	199.07	0.17	0.003	0.04	0.008	9.82	49.68	-5.41	22.26
ethylene glycol	153262	8.09	2088.9	203.5	0.09	0.002	0.02	0.004	10.88	51.59	-3.47	25.76
cresols p		7.035	1511.08	161.85	0.09	0.002	0.02	0.004	12.05	53.70	-0.89	30.39
glycol ethers	12179360											
methyl chloroform	720659											
tetrachloroethylene	365300											
isophorone	266591											
ethyl acrylate	20690											

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Date: July 31, 2000

Subject: Environmental and Energy Impacts for Coating Manufacturing Facilities
Miscellaneous Organic NESHAP
EPA Project No. 95/08; MRI Project No. 104803.1.049

From: Jennifer Fields
David Randall

To: MON Project File

I. Introduction

The purpose of this memorandum is to present the environmental and energy impacts and the approach used to estimate the impacts for proposed regulatory alternatives that were developed for the national emissions standards for hazardous air pollutants (NESHAP) for the miscellaneous coating manufacturing source category. The impacts that were estimated include: (1) primary air impacts; (2) secondary impacts, including air, water, and solid waste; and (3) fuel and electricity impacts. The impacts are presented for five types of emission points in the source category (process vessels, equipment leaks, storage tanks, wastewater, and transfer operations).

II. Basis for Impacts Analysis

Regulatory alternatives (including the maximum achievable control technology [MACT] floor) for existing sources are described in detail in the MACT floor and regulatory alternatives memoranda.[1-5] In summary, components of the MACT floor were developed for each of the five emission points in the source category, and regulatory alternatives also were developed as appropriate. The control devices or other techniques assumed to be used to comply with the MACT floor or regulatory alternatives are summarized in Table 1.

III. Primary Impacts

Primary air impacts consist of the reduction in HAP emissions from the baseline level that is directly attributable to the regulatory alternative. The primary impacts for the miscellaneous coating manufacturing source category is presented in Table 2. The uncontrolled emissions and baseline emissions are also shown in Table 2. The procedures used to estimate these emissions and emissions reductions are presented in previous memoranda.[1-6]

TABLE 1. ASSUMED CONTROL DEVICE OR APPROACH TO COMPLY WITH THE MACT FLOOR OR REGULATORY ALTERNATIVE

Emission source type	Control device or approach
Equipment Leaks	LDAR Program
Portable process vessels	Cover
Stationary process vessels	Cover and condenser
Storage tanks	Internal floating roof
Transfer operations	Condenser
Wastewater systems	Steam stripper or off-site disposal, depending on quantity

TABLE 2. SUMMARY OF PRIMARY IMPACTS FOR COATING MANUFACTURING

Emission point	Uncontrolled emissions, Mg/yr	Baseline emissions, Mg/yr	Emission reductions from baseline, Mg/yr		
			MACT floor	Regulatory alternative	Proposed MACT
Stationary process vessels	7,190	6,140	3,360	5,045	5,045
Portable process vessels	610	537	2.2	445	2.2
Equipment leaks	1,117	1,030	234	598	598
Storage tanks	64.5	63.8	0	2.5	2.5
Wastewater	14.2	13.5	10.7	11.1	10.7
Transfer operations	N/A	N/A	0	37.2	37.2
TOTALS					5,670

IV. Secondary Environmental Impacts

Secondary environmental impacts consist of any adverse or beneficial environmental impacts other than the primary impacts described in Section III of this memorandum. The secondary impacts are indirect or induced air, water, or solid waste impacts that result from the operation of the control system that controls HAP emissions. Use of most control systems described in Section II of this memorandum will cause secondary air impacts; secondary water and solid waste impacts, however, are expected to be minimal. The secondary air, water, and solid waste impacts are discussed in the sections below.

A. Secondary Air Impacts

Secondary air impacts consist of: (1) generation of emissions as the byproducts of fuel combustion needed to operate the control devices and (2) reductions in emissions of VOC compounds. These secondary air impacts are discussed below.

Fuel combustion is necessary to maintain operating temperatures in incinerators, to produce steam for steam strippers, and to generate electricity for operating fans, pumps, and refrigeration units. Byproducts of fuel combustion include emissions of carbon monoxide (CO), nitrogen oxides (NO_X), sulfur dioxide (SO_2), and particulate matter less than 10 microns in diameter (PM_{10}).

Steam was assumed to be generated in small, natural gas-fired industrial boilers. Combustion control devices (incinerators) also use natural gas as the auxiliary fuel. The estimated natural gas consumption rates are described in Section V of this memorandum. Emissions from combustion in both the boilers and the incinerators were estimated using AP-42 emission factors for small industrial boilers.[7]

Electricity was assumed to be generated at coal-fired utility plants built since 1978. The estimated electricity requirements, and the fuel energy needed to generate this electricity, are described in Section V of this memorandum. Utility plants built since 1978 are subject to the new source performance standards (NSPS) in subpart Da of 40 CFR Part 60.[8] These NSPS were used to estimate the PM_{10} and SO_2 emissions from coal combustion. The NO_X emissions were estimated using the AP-42 emission factor because the emission factor is lower than the level required by the NSPS.[9] The CO emissions were estimated using the AP-42 emission factor because the NSPS does not cover CO emissions.[9]

A summary of the estimated secondary air impacts that are generated for each of the five types of emission points in each source category is presented in Table 3. Secondary air impacts are generated from operation of condensers for process vessels, thermal incinerators for transfer operations, and steam strippers for wastewater streams. No secondary air impacts are associated with the use of floating roofs to control emissions from storage tanks or with the implementation of an LDAR program to control equipment leaks. Sample calculations are provided in Attachment 1.

In addition to the generation of emissions from fuel combustion for the operation of control devices, secondary air impacts also include the reduction of VOC emissions. The VOC compounds, which are precursors to ozone, include: (1) non-HAP VOC emissions and (2) HAP compounds that also are VOC compounds. The reduction of VOC achieved by the MACT floor and regulatory alternatives can not be quantified.

TABLE 3. SUMMARY OF SECONDARY AIR IMPACTS

Emission source type	Secondary air impacts, Mg/yr							
	MACT floor				Regulatory Alternative			
	CO [a]	NO_X [b]	SO_2 [c]	PM_{10} [d]	CO [a]	NO_X [b]	SO_2 [c]	PM_{10} [d]
Equipment leaks	0	0	0	0	0	0	0	0
Process vessels								
• Stationary	1.04	2.84	6.96	0.17	3.19	8.75	21.5	0.54
• Portable	0	0	0	0	0.74	2.04	5.0	0.12
Storage tanks	0	0	0	0	0	0	0	0
Transfer operations	0	0	0	0	0.0017	0.0047	0.011	0.0003
Waste water	0.009	0.035	0.01	0.0016	0.013	0.048	0.013	0.0022

[a] The CO emissions were estimated using AP-42 emission factors of 5 lb/ton of coal and 35 lb/10^6 ft^3 of natural gas.
[b] The NO_X emissions were estimated using AP-42 emission factors of 13.7 lb NO_X/ton of coal and 140 lb $NO_X/10^6$ ft^3 of natural gas.
[c] The SO_2 emissions were estimated using the NSPS for coal-fired utility boilers of 1.2 lb $SO_2/10^6$BTU and the AP-42 emission factor of 0.6 lb $SO_2/10^6$ ft^3 of natural gas.
[d] The PM_{10} emissions were estimated using the NSPS for coal-fired utility boilers of 0.03 lb $PM_{10}/10^6$ BTU and the AP-42 emission factor of 6.2 lb $PM_{10}/10^6$ ft^3 of natural gas.

B. Secondary Water Impacts

Secondary water impacts are expected to be minimal. Scrubbers may be used to control process vessels with a high halide content. However, because of the ease with which these emissions are controlled, this analysis assumes such emissions are already well controlled and that additional control will rarely be needed.

C. Secondary Solid Waste Impacts

Secondary solid waste impacts are expected to be minimal. At some plants, the overheads from a steam stripper (i.e., the mixture of steam and volatilized organic compounds may be a waste that needs to be disposed of). Other facilities, however, may be able to condense the overheads and return the condensed material to the process as either raw material or fuel. This analysis assumes the waste costs at some plants are balanced by the savings at other plants.

V. Energy Impacts

Energy impacts consist of the fuel usage and electricity needed to operate control devices that are used to comply with the regulatory alternatives. The estimated electricity and fuel impacts for each of the five types of emission points in the source category are presented in Table 4. In each case, the impacts are based on the total amount of electricity or fuel needed to operate the control devices; this approach overestimates the impacts because electricity and fuel needed for any existing, less efficient control devices are assumed to be negligible. The electricity and fuel impacts are discussed in detail in the subsections below.

TABLE 4. SUMMARY OF ENERGY IMPACTS

Emission source type	MACT floor						Regulatory Alternative					
	Increase in electricity use, kWh/yr	Increase in steam use, lb/yr	Increase in fuel energy, BTU/yr				Increase in electricity use, kWh/yr	Increase in steam use, lb/yr	Increase in fuel energy, BTU/yr			
			To generate electricity	Auxiliary fuel for incineration	To produce steam	Total			To generate electricity	Auxiliary fuel for incineration	To produce steam	Total
Equipment leaks	0	0	0	0	0	0	0	0	0	0	0	0
Process vessels												
• Stationary	1.31e+06	0	1.28e+10	0	0	1.28e+10	4.04e+06	0	3.94e+10	0	0	3.94e+10
• Portable	0	0	0	0	0	0	9.41e+05	0	9.18e+09	0	0	9.18e+09
Storage tanks	0	0	0	0	0	0	0	0	0	0	0	0
Transfer operations	0	0	0	0	0	0	2.15e+03	0	2.10e+07	0	0	2.10e+07
Waste water	1.83e+03	3.33e+05	1.79e+07	0	4.91e+08	5.09e+08	2.48e+03	4.52e+05	2.41e+07	0	6.67e+08	6.91e+08
TOTAL	1.31+06	3.33e+05	1.28e+10	0	4.91e+08	1.33e+10	4.98e+06	4.52e+05	4.86e+10	0	6.67e+08	4.93e+10

A. Electricity

Electricity would be needed to operate the control devices used to control emissions from process vents, storage tanks, and wastewater systems. As noted above, electricity was assumed to be generated in coal-fired boilers at utility plants. The amount of fuel required to generate the electricity was estimated using a heating value of 14,000 BTU/lb of coal and a power plant efficiency of 35 percent.

Specifically, electricity would be needed to operate the fans for the incinerators, and condensers; the refrigeration unit for condensers; and pumps for condensers and steam strippers. The power requirements for these devices were estimated using procedures outlined in the OAQPS Control Cost Manual and described in the MACT memoranda for each type of emission point.[1-6] No additional electricity would be needed to operate floating roofs for storage tanks or to implement an LDAR program for equipment leaks.

B. Fuel

Fuel would be needed to operate combustion control devices and to generate steam for steam strippers. In both cases, natural gas was assumed to be the fuel of choice. No additional fuel would be needed to operate condensers for process vessels, to operate floating roofs for storage tanks, or to implement an LDAR program for equipment leaks. The fuel requirements for each control device are included in the control device cost algorithms, which can be found in the MACT memoranda for the emission point of interest.[1-6]

The amount of natural gas needed in incinerators was estimated using mass and energy balances around the incinerators. The operating temperature was assumed to be 871EC (1600EF). Energy losses were assumed to be equal to 10 percent of the total energy input. Additional details on the procedure are described in the OAQPS Control Cost Manual.[10]

The steam used in steam-assist flares that control process vent emissions, and the steam used in steam strippers that are used to treat wastewater streams, was assumed to be at 177EC (350EF) and 6.8 atm (100 psia). The enthalpy change was estimated to be 1,180 BTU/lb steam, assuming the feed water to the boiler is at 10EC (50EF). The energy required to generate the steam was estimated assuming a boiler efficiency of 80 percent. The quantity of natural gas needed to supply the energy was estimated assuming the heating value of natural gas is 1,000 BTU/standard cubic foot.

VI. References

1. Memorandum from B. Shine, North State Engineering, to Project File. March 8, 2000. MACT Floor, Regulatory Alternatives, and Nationwide Impacts for Transfer Operations at Coatings Manufacturing Facilities.

2. Memorandum from B. Shine, North State Engineering, and D. Randall, MRI, to Project File. March 1, 2000. MACT Regulatory Alternatives and Impacts for Wastewater at Surface Coating Facilities.

3. Memorandum from D. Randall and D. Lincoln, MRI, to Project File. March 8, 2000. MACT Floor, Regulatory Alternatives, and Nationwide Impacts for Process Vessels at Coatings Manufacturing Facilities.

4. Memorandum from D. Randall, MRI, to Project File. March 13, 2000. MACT Floor, Regulatory Alternatives, and Nationwide Impacts for Equipment Leaks at Coatings Manufacturing Facilities.

5. Memorandum from D. Randall and J. Fields, MRI, to Project File. February 15, 2000. MACT Floor, Regulatory Alternatives, and Nationwide Impacts for Storage Tanks at Coatings Manufacturing Facilities.

6. Memorandum from B. Shine, North State Engineering, and D. Randall, MRI, to MON Project File. March 8, 2000. MACT Floor, Regulatory Alternatives, and Nationwide Impacts for Transfer Operations at Coatings Manufacturing Facilities.

7. AP-42. 1995 Edition. pp. 1.4-3 and 1.4-4.

8. 40 CFR Part 60. Subpart Da..

9. AP-42. 1995 Edition. p. 1.1-3.

10. OAQPS Control Cost Manual. Fourth Edition. EPA 450/3-90-006. January 1990. p. 3-31 and 3-32.

ATTACHMENT 1

SAMPLE CALCULATIONS FOR WASTEWATER SYSTEMS

SAMPLE CALCULATIONS FOR WASTEWATER SYSTEMS

A. Electricity used to run fans for wastewater systems (calculated using the cost algorithms in reference 2):

- 1,830 kwh/yr

B. Fuel energy required to generate electricity (assuming electricity is generated in a coal-fired power plant that has an efficiency of 35 percent):

$$\text{Energy, Btu/yr} = \left(1.83 \times 10^{3}\,\text{kwh/yr}\right)\left(3{,}415\ \text{Btu/kwh}\right)\left(\frac{1}{0.35}\right)$$

$$= 1.79 \times 10^{7}\,\text{Btu/yr}$$

C. Coal required to generate electricity:

$$\text{Coal, tons / yr} = \left(1.79 \times 10^{7}\,\text{Btu / yr}\right)\left(\frac{1\ \text{lb coal}}{14{,}000\ \text{Btu}}\right)\left(\frac{1\ \text{ton}}{2{,}000\ \text{lb}}\right)$$

$$= 0.64\ \text{tons coal / yr}$$

D. Steam used in steam-assist flares (calculated using the cost algorithms in reference 3):

- 3.33×10^{5} lb steam/yr for wastewater systems

E. Fuel energy required to generate steam (assuming steam at 350EF and 100 psia is generated from water at 50EF in a boiler with an efficiency of 80 percent):

$$\text{Energy, Btu / yr} = \left(3.33 \times 10^{5}\,\frac{\text{lb steam}}{\text{yr}}\right)\left(1{,}180\,\frac{\text{Btu}}{\text{lb}}\right)\left(\frac{1}{0.8}\right)$$

$$= 4.91 \times 10^{8}\,\text{Btu / yr}$$

F. Natural gas used to generate the steam:

$$\text{NG, scf / yr} = \left(4.91 \times 10^{8}\,\text{Btu / yr}\right)\left(\frac{1\ \text{scf NG}}{1{,}000\ \text{Btu}}\right)$$

$$= 4.91 \times 10^{5}\,\text{scf NG / yr}$$

G. CO emissions (a similar calculation is used for NO_x emissions):

$$\text{CO, Mg / yr} = \left(\left(0.64\frac{\text{tons coal}}{\text{yr}}\right)\left(\frac{5\text{ lb CO}}{\text{ton coal}}\right) + \left(\frac{4.91\times10^{7}\text{ scf NG}}{\text{yr}}\right)\left(\frac{35\text{ lb CO}}{10^{6}\text{ scf NG}}\right)\right)\left(\frac{1\text{ Mg}}{2{,}204\text{ lb}}\right)$$
$$= 0.009\text{ Mg CO / yr}$$

H. SO_2 emissions (a similar calculation is used for PM_{10} emissions):

$$\text{SO}_2\text{, Mg / yr} = \left(\left(1.79\times10^{7}\frac{\text{Btu}}{\text{yr}}\right)\left(\frac{1.2\text{ lb SO}_2}{10^{6}\text{ Btu}}\right) + \left(\frac{4.91\times10^{5}\text{ scf NG}}{\text{yr}}\right)\left(\frac{0.6\text{ lb SO}_2}{10^{6}\text{ scf NG}}\right)\right)\left(\frac{1\text{ Mg}}{2{,}204\text{ lb}}\right)$$
$$= 0.01\text{ Mg SO}_2\text{ / yr}$$

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Date: October 16, 2000

Subject: Estimation of HON LDAR Costs for Example Coatings Manufacturing Facility
Miscellaneous Organic NESHAP
EPA Project No. 95/08; MRI Project No. 104804.1.057

From: Brenda Shine, North State Engineering

To: MON Project File

I. Introduction

The National Paint and Coatings Association (NPCA) conducted an independent analysis of EPA's Leak Detection and Repair (LDAR) analysis. In Attachment C of the September 13, 2000 letter to Mr. Eric Haxthausen, of OMB, from David Darling of NPCA, the industry provides data that could be used to estimate the cost of a HON LDAR program at an example facility. This memorandum describes the data and provides an estimate of LDAR cost effectiveness based on these data.

II. Facility-Specific Information

In Table 2 of Attachment C of the above-referenced document, the NPCA provides equipment leak history data from PPG Industries' Oak Creek, Wisconsin facility. The data span the years 1991 through 1999. Interestingly, the leak rates increase with the years, so that the initial leak frequency appears considerably lower (0.05 percent) than the subsequent leak frequency (0.77 percent) in the last year for which data is provided. This trend is not expected and indicates that the LDAR program at this facility has a negative effect – the longer the program is in existence, the greater the number of leakers and the higher the emissions are from the facility. The NPCA makes the point that the leak rates found at this facility are considerably less than those used in the EPA analysis, which is true. Since leak rates and component counts are the most important variables in the cost effectiveness analysis, we estimated emissions for a model program using these leak rates. However, we assumed that the initial leak rate would be 0.77 percent and that the subsequent leak rates would be at the performance level of the LDAR program. Secondly, the leak rates provided by the NPCA are not specific to the type of component. Therefore, we assumed that all components would be leaking at these rates.

III. LDAR Program Estimate

An estimate of cost effectiveness of a HON LDAR program requires initial and subsequent leak frequencies and total component counts. Using the 0.77 percent leak rate for all components as the initial leak frequency and the LDAR level of performance (0.25 percent for valves and connectors, and half the initial leak rate for pumps, we were able to do some cost effectiveness comparisons. For the small HON model process component count of 6 pumps, 30 valves, 100 connectors, 2 sampling connections, and 2 open-ended lines, we found the cost effectiveness of a HON program to equal approximately $18,000/Mg. The net reduction in this case was calculated to be 0.56 Mg/yr. However, if the number of components is increased by a factor of 10 (i.e., to 1,400 overall), the cost effectiveness decreases to approximately $3,000/Mg. This is because the cost of the program per unit of reduction decreases, since certain administrative and monitoring costs are not linear with component counts. Therefore, the larger the number of components, the more cost effective the LDAR program becomes. The component counts provided by the NPCA are in the range of 50,000 components per facility. Therefore, we expect that the cost effectiveness of an LDAR program at these leak rates and component counts would also be within the same range or even better (less than $3,000/Mg).

IV. Conclusions

The data submitted by NPCA indicates that the LDAR program at the facility is not effective at all, since leak rates increase with the implementation of the LDAR program. However, it is conceivable that the application of an LDAR program for components that have leak rates on the order of what was submitted by the NPCA is cost effective.